VEOLIA WATER SOUTHEAST

Adapting to Climate Change

A report to Defra and the Secretary of State in response to a direction to report under the Climate Change Act 2008

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NOTE

This document has been compiled in order to comply with the new requirement to report our climate change adaption strategy to DEFRA. The format of the executive summary of this report is as specified in the evaluation guidelines issued by Cranfield University

EXECUTIVE SUMMARY

1. Information on organisation	
Name of organisation	Veolia Water Southeast Limited
Organisation's functions, mission, aims, and objectives affected by the impact of climate change	We are a water only supply company operating in the South East of England. This is one of the driest regions of the country; in March 2006, the company was the first in the country to apply for and be granted "Area of Water Scarcity" status by the government. We supply 43 million litres of water a day to 160,000 customers across a supply area measuring around 420km^2. As a water services company, our business operations are intrinsically linked to the weather. Our functions which we believe may be affected by climate change are: *Managing Water Resources Sustainably*: Sustainable water management is at the heart of our business. Our job is to ensure that supplies of water to our customers remain secure and of the highest quality with least effect on our environment. *Meeting Future Demand for Water:* We have a duty to provide sufficient quantities of water to meet the demands of all our customers. We work to reduce the increase in future demand for water through water efficiency operations, reducing leakage, and providing information to our customers on the importance of saving water. *Providing Water Which Meets Drinking Water Inspectorate Standards*: We are committed to providing safe, high quality drinking water for our customers. We do this by operating and maintaining our assets diligently along with sampling and testing the quality of the water we supply. We aim for 100% compliance in treated water quality and achieved 99.98% last year. *Providing a Reliable Network Infrastructure which Adheres to Regulation:* We have over 1100 kilometres of underground pipes which are prone to movement from shrinkage and expansion. These pipes are sensitive to adverse weather conditions.

2. Business preparedness before Direction to report was issued.	
Has your organisation previously assessed the risks from climate change?	We have assessed the risks from climate change as part of our Water Resources Management Plan, Drought Management Plan and Business Plan. Climate change is just one of the strategic risks accounted for in our planning. We also undertake research to assess the risk of climate change across sections of our business which are not fully understood. Examples of this include research to quantify the effect climate change may have on the quality of our raw water resources.
If so, how were these risks and any mitigating actions incorporated into the operation of your organisation?	Our statutory functions, powers and duties are established in UK law through relevant legislation principally the Water Industry Act 1991 and its subsequent amendments. The UK water industry is highly regulated through a number of organisations including: • Ofwat (The Water Services Regulation Authority) the economic regulator of the water and sewerage sectors in England and Wales. • The Environment Agency are responsible for protecting the environment and provide Guidelines for producing Water Resources Management Plans and Drought Management Plans. • The Drinking Water Inspectorate who continually monitor the quality of the water that supplied to ensure that it complies with EU and UK standards. • The Health and Safety Executive within the workplace. • Non-government agencies, including consumer organisations and environmental stakeholders, also play a large part in informing water policy and practice across the sector. Amongst other regulatory submissions, we are required to prepare and submit Business Plans to Ofwat and, Water Resources Management Plans and Drought Management Plans to the Secretary of State to explain our proposals for securing and maintaining supplies of water over a 25 year planning horizon. The process of preparing and submitting these documents has enabled us to assess the impact of, formulate action plans for, and secure funding to enact climate adaptation measures. The Plans are reviewed and updated regularly.

3. Identifying risks due to the impacts of climate change	
What evidence, methods, expertise and level of investment have been used when investigating the potential impacts of climate change.	Our approach to investigating the potential impacts of climate change differs according to risk factor and the following methods have been used. In all cases UKCP09 projections of future climate change have been used as the standard climate change forecast: *Water scarcity*. A number of studies have been carried out including forecasts of the amount of water available to meet the demand of our customers until 2035. We are able to quantify effects on both our future supply capability and customer demand and these are combined to assess any actions needed to maintain security of supply. This work culminated in our Water Resources Management Plan and Drought Management Plan. *Flood Risk.* Flood risk mitigation requires capital expenditure and is addressed by our Business Plan. Our recent flood risk studies were undertaken by independent consultants Jacobs to identify potential sites at risk, quantify the threat and design adaption measures.

4. Assessing risks	
How does your organisation quantify the impact and likelihood of risks occurring?	Our risk register ranks our strategic risks with a calculation that considers the likelihood and severity of each risk. This allows for easy comparison of areas needing action more than others. Likelihood is scaled from "(0) Zero Likelihood" to "(5) Likely and Imminent" with severity scaled similarly. Eight different categories are examined in the risk register. *Water scarcity.* We quantify the future supply/demand balance and also assess their uncertainty. First, future water resource availability is calculated by evaluating the results of a number of studies detailed in our Water Resources Management Plan. This study considered factors likely to reduce supply levels such as climate change. Secondly, future demand levels are forecast assessing ownership, frequency and use of water using appliances and behaviours and by combining estimates of the effect of water efficiency with future population forecasts. To account for uncertainty and flexibility, a 'headroom' margin is applied to the supply demand balance. *Flood Risk*. We commissioned consultants Jacobs to assess the effect flooding may have on our water production sites. This study quantified the level and frequency needed for a flood to cause damage and/or loss of supply.

5. Uncertainties and assumptions	
What uncertainties have been identified in evaluating the risks due to climate change?	*Legal and regulatory uncertainties*: Our legal and regulatory responsibilities will evolve over time and we will face new challenges that may affect our plans for climate change adaption. *Data reliability*: We have used a range of external data sets such as the UKCP09 projections as well as flood maps from the Environment Agency. These data are the most accurate available but with all forecasts, an element of uncertainty remains. We have allowed for a level of uncertainty in our planning where the scale of risk has been assessed. *Water quality*: We are aware that climate change may affect the quality of our raw water resources however this is uncertain. We have identified this area for further research. *Effects of climate change*: The scale of UKCP09 projections are based on a range of global weather models with inherent uncertainty accordingly the frequency and severity of extreme weather events are difficult to accurately predict. *Risks to administrative operations:* Like all businesses, we rely heavily on a number of other key sectors such as telecommunications, transport, and energy generation. We are unsure as to how climate change may have consequences on our ability to maintain operations until we can quantify the effect of climate change on these sectors which remain key to our service.
What assumptions have been made?	We have assumed that external data and projections are accurate but included an assessment of uncertainty in our analysis. We also assume that future financial, regulatory, and legal circumstances will remain relatively unchanged and that our business functions will not be significantly different within our planning horizon. For example, we assume that our operational area and business model remains constant and that we will continue to be fully funded to fulfil our regulatory obligations and targets.

6. Addressing current and future risks due to climate change - summary

BUSINESS FUNCTION	*CLIMATE VARIABLE*	*PRIMARY IMPACT OF CLIMATE VARIABLE*	*THRESHOLDS ABOVE WHICH THIS WILL AFFECT BUSINESS*	*LIKELIHOOD OF THRESHOLDS*	*POTENTIAL IMPACTS ON ORGANISATION AND STAKEHOLDERS*	*PROPOSED ACTION TO MITIGATE IMPACTS*	*TIMESCALE OVER WHICH RISKS ARE EXPECTED TO MATERIALISE AND ACTION IS PLANNED*
Managing water resources. sustainably	Coastal Erosion	Increase in salinity of water extracted via storm surge– lead to loss of resource or addition of treatment.	Deployable Output is reduced at coastal sources.	1 in 20 year likelihood (i.e. a 5% probability)	Requirement for additional treatment (1 site). If lost site and drought period could have medium term impact.	Continual monitoring of situation, demand reduction measures, water efficiency measures, i.e. metering/leakage detection, support of supply demand balance to compensate for loss of any resource	By end of 25 year planning horizon.
	Variation in Precipitation	Reduction of 11% in groundwater levels and increased likelihood of drought.	Considered in headroom analysis calculations detailed in WRMP	Accurate depending on reliability of data and modelling used	More frequent implementation of drought plans i.e. compulsory restriction orders	Continual monitoring of situation, demand reduction measures, water efficiency measures, i.e. metering/leakage detection, support of supply demand balance to build resilience against drought into operations.	Demand to exceed supply by 2035. Continue with water efficiency operations . Monitoring undertaken continually and reported on periodically.
Meeting future demand for water	Changes in temperature	Increase in temperature leading to increase in water usage during summer months.	Increase in use exceeds supply available.	At current rates, demand including headroom will overtake supply by end of planning horizon	Demand levels predicted to remain relatively steady but could rise depending on data reliability. Likelihood of increase in temperature unknown – however if rise in temperature is experienced – rise in demand very likely.	Consider additional investments to meet increased demand.	Ensure supply exceeds demand, water efficiency operations including leakage operations, improve network efficiency, promotion of water efficiency behaviour, regular review of drought plan, explore options for increasing supply, import water from elsewhere to meet demand, improve supply resilience etc
	Flooding	Loss of/damage to physical assets required to deliver water	Potentially 1 in 100 year plus 20% flow event at best case scenario. For selected sites – 1 in 10 year event.	Minimum of roughly 1 in 400 probability. Maximum of 1 in 10 probability.	Loss/degradation of supply as well as increased reliance on emergency supplies.	Increased storage, raising of plant equipment, analysis of localised effects of flooding, increase network resilience, other flood defence works as detailed in report.	Unknown: risk may materialise over many decades. Current work due for completion by end of planning period. Periodic review of progress in statutory Plans.
Providing a reliable network which adheres to regulation	Variable Temperature Future weather patterns are less predictable.	Shrinkage and swelling of ground due to variations in temperature increasing incidence of leaks.	Unknown	Unknown although evidence shows correlation between temperature fluctuation and bursts.	Increased burst rate, disruption due to fixing, associated financial, energy, and carbon costs of repair, Cost and disruption of increased replacement of network. Increased water wastage, potential for supply to not be sufficient due to leakage.	Continued replacement of network, continued efforts to reduce pressure in network, providing alternative methods of asset delivery, improvements in monitoring and prediction so that leaks can be found and fixed quickly, environmental accounting to justify investment.	Adherence to ELL until cost of repair outweighs cost of replacement. Timescale not currently definable.
		Prevention of fulfilling administrative functions from damage to transport/communications network	Unknown	Unknown	Reduction in manpower, inability to fulfil statutory obligations, inability to remain flexible in event of emergency	Continual monitoring of situation, flexible working arrangements, increase accessibility to physical assets.	Continual – no risk perceived within planning horizon.
Providing water which meets drinking water standards	Flooding	Pollution of water due to flood. Surface water flooding (run off).	Potentially 1 in 100 year plus 20% flow event at best case scenario. For selected sites – 1 in 10 year event.	Minimum of roughly 1 in 400 probability. Maximum of 1 in 10 probability.	Loss/degradation of supply as well as increased reliance on emergency supplies. Increase in treatment needed.	Increased storage, raising of plant equipment, analysis of localised effects of flooding, increase network resilience, other flood defence works as detailed in report.	Unknown: risk may materialise over many decades. Current work due for completion by end of planning period. Periodic review of progress in statutory Plans.

7. Barriers to Implementing adaptation programme	
What are the main barriers to implementing adaptive action?	*Regulation and Legislation*: Many of our regulatory requirements are not conducive to a climate change adaptation programme. For example, our financial regulation structure makes justification of long term projects difficult with a relatively short 5 year Business Planning cycle. We propose to work closer with our regulators to resolve these issues. *Resources:* We may find ourselves in a situation where adaptation actions have been identified but investment has not been included within price limits for the near future e.g. Flood works. As a result we are unable to devote resources to ensure successful completion of the programme. This is a problem all companies will face and we will have to develop a new framework to evaluating the costs and benefits for projects specifically aimed at adapting to climate change. *Knowledge*: Uncertainties in many areas are preventing us from acting. Devoting substantive resources on projects based on qualitative or indicative data is unwise. With more information on the specific effects of climate change, we can create specific adaptation actions which we are sure are appropriate. We will continue our research and collaboration with relevant authorities to overcome this.
Has the process of doing this assessment helped you identify any barriers to adaptation that do not lie under your control?	*Interdependencies and Stakeholders*: We must justify our operations not only to our regulators but to our customers and other relevant stakeholders also. For example, we may not justify projects to improve water quality if the out come of this project is detrimental to the environment. We also rely heavily on other sectors, for example energy production and transport. If these sectors are unprepared then these may undermine our adaptation actions. To overcome this we will continue to liaise with all relevant stakeholders and interdependencies and aim to work together to overcome barriers.

8. Report and review	
How will the outcome of the adaptation programme be monitored and evaluated and what is the timetable for this?	We monitor the outcome of our projects and report these annually in regulatory returns. We prepare Plans for submission to our financial regulator on a 5 yearly basis and we consult on and prepare Water Resources Management Plans that include assessment of investments needed to adapt to accommodate climate change effects for approval by the Secretary of State. These Plans are monitored and updated annually.
How do you propose to monitor thresholds above which impacts pose a threat to your organisation (including the likelihood of these thresholds being exceeded and the scale of the potential impact)?	Where current thresholds are known, we will continue to monitor these and report via our Plans. Where thresholds are currently unknown, our periodic monitoring will ensure that when this information becomes available we will be in a position to act on it.
How will the benefits of the programme be realised and how will this feed into the next risk assessment and options appraisal?	When we begin to experience the benefits from our proposed adaptation actions, we will report these back through our relevant Plans. This information will then feed into our corporate risk register which is continually updated. If and when additional issues arise, these will be assessed and added to the risk register. Monitoring of this will take place and be reported on in our Plans.
How have you incorporated flexibility into your approach?	We have built resilience into our operations to preserve security of supply to our customers, for example by preparing for flood events of 1 in 100 year flow + 20%. This additional 20% allows for an increased margin of safety to overcome uncertainties in our flood predictions. For water scarcity we have specifically allowed for flexibility in our headroom calculations for our supply/demand balance forecasts. Our constant monitoring and evaluation approach enables us to remain flexible to respond to risks as they materialise.

9. Recognising opportunities	
What opportunities due to the effects of climate change and which the organisation can exploit have been identified?	No opportunities that have the potential to make a noticeable difference on our operations have been identified. If and when opportunities do materialise, these will be reported on in our Plans.

10. Further comments/ information	
Do you have any further information or comments which would inform Defra (e.g. feedback on the process, the statutory guidance, evidence availability, issues when implementing adaptation programmes, challenges etc)?	*Climate change adaptation is embedded in our long term investment planning to secure an adequate margin over 25 years between water resource availability and demand for water. However although we anticipate that water resource availability will reduce in future years due to the combined impacts of climate change and implementation of the Water Framework Directive, the current regulatory guidelines for water resource planning prevent us from taking account of a quantity of lost resource beyond 2015 in our investment plans.*

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1 INTRODUCTION

Veolia Water Southeast (VWSE) supplies water throughout Folkestone and Dover in South East Kent and surrounding rural areas, including Romney Marsh and Dungeness. The Company provides a reliable, safe supply of high quality drinking water to its customers; and is committed to ensuring a sufficient and continued supply of water in the future.

Its statutory functions, powers and duties are established in UK law through relevant legislation principally the Water Industry Act 1991 and its subsequent amendments. The UK water industry is highly regulated through a number of organisations appointed by Defra including:

- Ofwat (The Water Services Regulation Authority) the economic regulator of the water and sewerage sectors in England and Wales.
- The Environment Agency responsible for protecting and promoting the environment.
- The Drinking Water Inspectorate who continually monitor the quality of the water supplied to ensure that it complies with EU and UK standards.
- The Health and Safety Executive within the workplace.
- Non-government agencies, including consumer organisations (Consumer Council for Water) and environmental stakeholders, also play a large part in informing water policy and practice across the sector.

Amongst other regulatory submissions, we are required to prepare and submit Business Plans to Ofwat at 5 yearly intervals, Water Resources Management Plans and Drought Management Plans to the Secretary of State to explain our proposals for securing and maintaining supplies of water in the future.. The process of preparing and submitting these principal planning documents has enabled us to assess the impact of, formulate action plans for, and secure funding to enact climate change adaptation measures.

1.1 Climate Change Adaptation

Section 61 of the Climate Change Act 2008 gives the Government the power to require Reporting Authorities to prepare and submit climate change adaptation reports for the Secretary of State taking into account the reporting guidelines prepared by Defra. As one of around 100 leading organisations we have been required by the Secretary of State to prepare this report detailing;

- How we have assessed that climate change is already impacting on our organisation, and how it might impact in the future.
- Our proposals to adapt to climate change.

The work of UKCIP and others has produced tools and approaches that can help to identify and assess impacts. This combined with our extensive historical data sets and years of reporting and expert analysis mean Veolia Water Southeast is in a robust position to identify and evaluate potential impacts and propose actions to adapt to the emerging risks associated with climate change.

1.2 This Report

This report follows a similar format to that of the executive summary from the statutory guidance document. To populate this report evidence from the Business Plan, Water Resources Management Plan, Drought Plan, and a number of other published documents has been used.

Climate change is just one of the strategic risks embedded in our company conscience. Where possible, we have detailed current adaptation actions, as these are already published in statutory plans. Where we have identified potential consequences, not covered by existing plans, we have made suggestions of what should be implemented.

2 WHO WE ARE AND WHAT WE DO

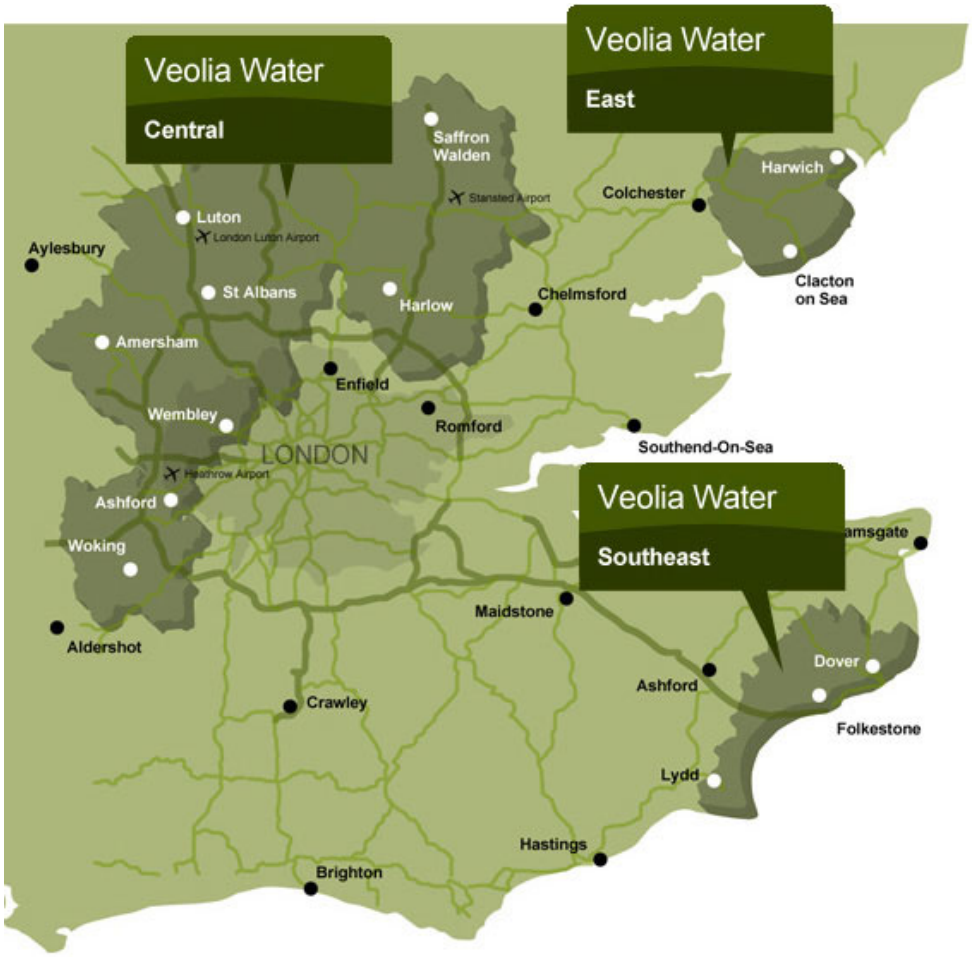
Current Defra climate change scenario predictions indicate that weather in our region will become more extreme in the winter and summer. Average annual precipitation will remain relatively unchanged, but will be more intense in the winter leaving us with drier summers.

Water supply is an area where many of the consequences of climate change will be experienced first and most acutely. This puts the water industry at the forefront in adapting to a changing climate. We have experience in planning and adapting to uncertainty in water supply which is reflected in our investment strategies and Business Plans.

2.1 About Veolia Water Southeast

We are a water only supply company operating in the South East of England as Figure 2.1.a shows. This is one of the driest regions of the country; in March 2006, the company was the first in the country to apply for and be granted "Area of Water Scarcity" status by the government.

Figure 2.1.a: Veolia Water Southeast within the Southeast of England.



We supply 43 million litres of water a day to 160,000 customers across a supply area measuring around 420km^2.

2.2 Veolia Water Southeast Business Functions

As a water supply company, our business operations are intrinsically linked to the weather; as the climate changes, so too must the way we operate. The following section identifies our main business functions which we believe are potentially at risk to the climate change predictions detailed by the UKCP09 findings.

All of our business functions must be delivered at a price which the customer is willing to pay for.

2.2.1 Managing Water Resources Sustainably

Sustainable water management is at the heart of our business. Our Water Resources Management Plan show that there is currently sufficient clean, wholesome water available to us, but we also have to balance the competing pressures of economic growth, pollution risk, environmental protection, and of course; climate change. Our job is to find a way of balancing those pressures whilst ensuring that supplies of water to our customers remain secure and of the highest quality.

2.2.2 Meeting Future Demand for Water

We are obligated to provide water in sufficient quantities to meet the demands of all our customers. We want to do this at a price that is affordable and which takes into account the effects of climate change so that we are able to function as a business into the future.

The continued serviceability of our network infrastructure is essential for the constant delivery of a wholesome product in the quantities demanded. Without the proper and full operation of these assets, we cannot supply water safely and reliably. The identified risks posed by climate change (such as increased flood propensity) could see the reliability of these assets diminished and with it, our ability to meet demand.

2.2.3 Providing Water Which Meets Drinking Water Inspectorate Standards

We have a duty to provide water in sufficient quantities to meet the demands of all our customers. We want to do this at a price that is affordable and which takes into account the effects of climate change.

The quality of raw water from our sources is constantly under threat of pollution and our studies show it is deteriorating. We monitor groundwater, assess risks regularly and install appropriate treatment where necessary to ensure compliance with drinking water standards.

Providing water of sufficient quality is a regulatory requirement, we need to respond with positive action to retain our customers' faith and confidence in our water.

2.2.4 Providing a Reliable Network Infrastructure which Adheres to Regulation

Our network of underground pipes extends to over 1,000 kilometres and is replaced at a rate designed to achieve stable serviceability. We react quickly to ensure that supplies are returned to normal following bursts. The effect of climate change could cause burst rates to increase which would lead to an increase in the rate of renewal.

3 OUR RISK ASSESSMENT APPROACH

Due to the varying nature of our business it is impossible for us to adopt a single methodology for assessing and quantifying all our risks. We employ different methodologies for different types of risk. This section will describe the risk management process for strategic risks which threaten to affect our business objectives.

Climate change is considered a contributory factor towards some of our strategic risks (for example the risk of long term insufficiency of water), rather than a strategic risk in itself. Appendix C lists the risks which are likely symptoms of the UKCP09 projections on a likelihood/severity matrix.

It is for this reason that VWSE is unable to differentiate the effect that climate change may have on our operational performance despite being well prepared for changes in the environment. Our periodic plans describe the effect of climate change on our operations and the proposed actions to facilitate adaption. It is primarily through this process that climate change risks are identified, explored, and monitored. One of the aims of this report is to demonstrate that we consider climate change in our planning and that, through our continual monitoring and periodic review processes, we are well prepared.

For each of our specific identified risks, the methodology used has been described in the relevant sections of this report.

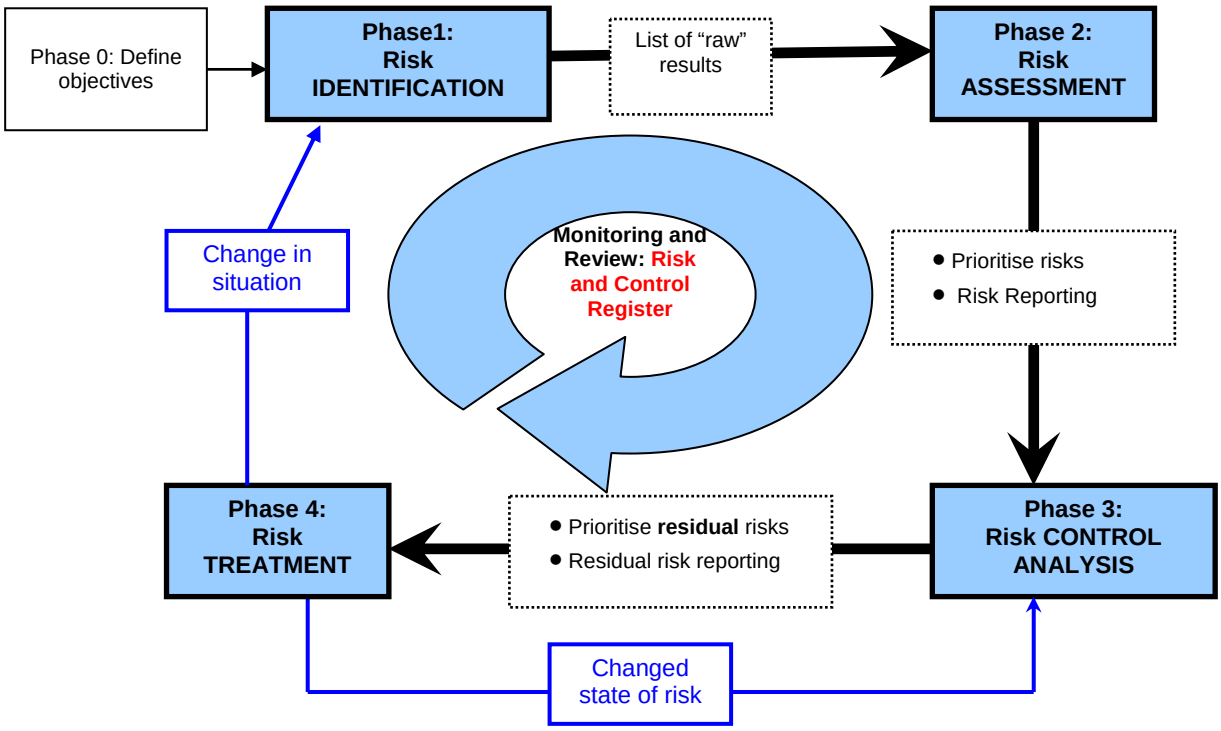
3.1 Significant Risk Management Process

We believe that risk management should be an active, continuous and developing process which runs throughout our organisational strategy and should methodically address all the risks surrounding our current and future activities.

Risk management at Veolia Water Southeast is integrated into the culture of the organisation through an effective policy and program led by senior management. It translates the strategy into tactical and operational objectives, assigning responsibility throughout the organisation and support accountability and reward, thus promoting operational efficiency at all levels.

Our approach is very similar to the UKCIP, Defra and Environment Agency framework *(Climate Adaptation: Risk, Uncertainty and decision-Making - UKCIP Technical Report. May 2003)* in that it is a continuous improvement cycle but as Figure 3.1.a shows; is flexible and appropriate to our organisation and the water industry as a whole.

Figure 3.1.a: Veolia Water risk assessment methodology structure



This section aims to describe the process used when forming our significant risk register. As mentioned, it is not specific to climate change but enables us to remain prepared and flexible to changing conditions. The process itself is in four broad phases, *Risk Identification, Risk Assessment, Risk Control Analysis* and *Risk Treatment*.

3.1.1 Phase 1 - Risk Identification

Risk identification is the first step of the process and aims to identify where the risks may arise. It has to be approached in a methodical way to ensure that all significant activities within the organisation are identified and all risks flowing from these activities are defined.

Risks are identified as comprehensively as possible by one or more of the following techniques: Check List, Questionnaires, Interviews/Experience, Brainstorming Workshop, Assumption Analysis, Expert Facilitation and by the review of reports including audit outputs, incident investigations, changes in legislation or regulation etc. The approach adopted involves all activity stakeholders and takes into account the experiences they may have had of past comparable projects or existing operations.

Following successful completion of the identification phase, each risk is entered into the risk register under the "Significant Risk" heading.

At this point in the process the 'risk owner' is identified and allocated; usually someone whose activities would be affected if the threat materialised. .

3.1.2 Phase 2 - Risk Assessment

Once the risks have been identified in sufficient detail, they can be assessed in terms of probability of occurrence (likelihood) and potential impact (severity) of that occurrence in order to provide a ranking to prioritise those that are most significant. In doing so, risk

response is targeted to achieve the greatest effectiveness in risk reduction based on these two parameters. The assessments are undertaken by those experienced with the risks in question. In Phase 2, risks are assessed without controls in place.

The probability for each risk are scored from 0 (zero likelihood) to 5 (likely and imminent) and entered into the "Likelihood" column of the risk register. Table 3.1.a outlines this classification.

Table 3.1.a: Risk Assessment probability classification

	Zero Likelihood	Highly Unlikely	Possible in Long Term	Possible in Med. Term	Likely in Short Term	Likely & Imminent
Likelihood Ranking	Will not happen	Has occurred / will occur in the last / next 10 or more years	Has occurred / will occur in the last / next 5 – 10 years	Has occurred / will occur in the last / next 3 – 5 years	Has occurred / will occur in the last / next 1 - 2 years	Has occurred / will occur several times per year

Once a score for likelihood has been obtained, a different process is used to determine the severity of each risk. The impact/severity should be scored from 0 (zero impact) to 5 (very serious). The severity for each risk identified is scored against 8 potential impact categories.

These are listed below:

- Water Quality
- Financial
- Regulatory
- Reputation
- Health and Safety
- Customer Satisfaction
- Legal
- Environment

Guidance for scoring the severity of risk against the 8 categories referred to above is provided in Table 3.1.b

Table 3.1.b: Risk Assessment severity classification

Severity Category	0	1	2	3	4	5
Water Quality	No Impact on water quality	Near miss situation	Reliant on standby measures, action required to rectify	Significant DWI Notifiable incident	Potential DWI / other regulatory prosecution	Potential crown prosecution e.g. corporate manslaughter
Financial	No impact on financial targets	<£100,000	£100,000 - £250,000	£250,000 - £500,000	£500,000 to £1,000,000	> £1,000,000
Regulatory	No impacts	Confidential contact (telephone/letter)	Request for additional information requirements.	Regulatory questioning	Regulatory penalty	Withdrawal of licence
Reputation	No adverse media attention/coverage	-ve coverage of water industry	Possible local media attention/coverage	Adverse local/regional media coverage	Adverse national media coverage	Extensive adverse national/international coverage
Health, Safety	No Impact on employee/public health and safety	Non-reportable injury	Reportable accident under RIDDOR	Serious reportable injury requiring long term absence	Multiple serious injuries	Multiple deaths
Customer satisfaction	No impact on customers supplies No impact on existing level of service	Near miss situation/failure to supply. Minor impact on any one DG indicator	Failure to supply 0.5% of properties Downgrading of ranking on any one DG indicator	Failure to supply 0.5% to 1% of properties Downgrading of ranking on more than one DG indicator	Failure to supply 1% to 5% of properties Downgrading to bottom of league on one DG indicator.	Failure to supply > 5% of properties Downgrading to bottom of league on more than one DG indicator
Legal	No impact	Legal advice required	Exchange of correspondence with third party solicitors	Civil claim for damages instigated against the company	Criminal prosecution	Succesful Crown Court prosecution
Environment	No adverse environmental impact	Small unexpected release of greenhouse gas Inappropriate dewatering Slight damage to habitat	Near Miss Situation Breach of discharge consent Damage to habitat – recovery in 6 months	Small reportable toxic leak Legislative non-compliance Damage to habitat – recovery in 12 months	Toxic leak Pollution of major water course HSE/EA prosecution Major recoverable impact to SSSI site	Major toxic leak Significant fish/flora kill Irrecoverable impact to SSSI site

These categories are individually scored from 1 to 5. The sum of all severities is multiplied by the likelihood rating to give an overall risk score. This manner of scoring allows for quick and easy ranking of risks in order to highlight where control actions are needed most.

3.1.3 Phase 3 - Risk Control Analysis

The purpose of this phase is to identify controls that can help mitigate and manage the risks that have been identified and scored in Phase 1(risk identification) and Phase 2 (risk assessment). This is the responsibility of the risk owners and line managers who are responsible for the activity.

A similar process used to identify risks is used to identify potential controls. This stage aims to assess if the current control is appropriate.

There are many different types of controls. They tend to fall into four categories.

- **Directive controls** – defined instructions and include things such as policies, procedures, signs, posters etc.
- **Preventative controls** –ensure that appropriate access is maintained, for example: locks, fences, passwords, training, physical barriers, software barriers.
- **Detective controls** – ensures that there is appropriate accessibility to information, such as: testing, inspections and sampling records.
- **Corrective controls** – ensure that identified issues can be remedied. This may be applied in situations where it may be impossible to predict when and where an incident may happen and include continuity planning ensuring gaps can be filled, technical solutions can be applied and training can be provided.

Once existing controls currently in place to mitigate risks have been identified, the likelihood and the severity of the risk will be re-assessed in the same manner as detailed in Phase 2, in order to calculate the residual risk. If no controls exist the residual risk score will stay the same as the initial risk score calculated in Phase 2.

When controls are identified and residual risk scored, this information is added to the risk register and a ranking given to each identified risk to highlight where additional action is needed.

3.1.4 Phase 4 - Risk Treatment

Effective risk management requires a reporting and review structure to ensure that risks are effectively identified and assessed and that appropriate controls and responses are in place. Existing controls identified in Phase 3 will be monitored by the risk owner and it is their responsibility to decide if the residual risk score is acceptable. If the residual risk is too high or if there are no current controls in place for the risk, new controls have to be implemented as action plans to mitigate the risk.

If the residual risk score is not acceptable the risk owner needs to decide upon a suitable target score and create actions to help reach that target score. The actions will attempt to help the risk reach the target score through either mitigation, avoidance (or both). To help monitor the process, new actions are given a completion date and the risk manager responsible for each action is named.

For each of these instances we evaluate the potential next steps, known as “The 4 T’s”. These are:

- **Tolerate**

  We reluctantly choose to accept the inherent risk if the cost of control heavily outweighs any potential benefits. Tolerated risks are common and steps are always taken to ensure that the risk is minimised. As and when a suitable control action is identified, it may be implemented.

- **Terminate**

  The project or operation is cancelled or ceased. This occurs if the threat of the risk is too great and no suitable control action can be found.

- **Transfer**

  The responsibility of the project or operation is shared with another organisation, for example, external contractors are hired. For specialist projects, it is often the preferred route in order to ensure that the project is undertaken by staff appropriately equipped for the associated risks. This option however is only used if all internal possibilities have been explored.

- **Treat**

  The risk is reviewed and an appropriate control action developed which is fit for purpose. This would involve controlling and managing both the likelihood and severity of the risk on the project or operation.

At the end of this phase, when the action plan has been implemented, the risk is reassessed, with the outcome from the action forming the new current control in the register. The risk, with the new control, is then rescored and the risk owner compares this score with the action logs original target score. The risk owner then assesses whether the new residual risks score is now acceptable. If not, a new target score is selected and a new action plan is drafted. This form of review continues until either the situation changes and then the process restarts at Phase 1, or all the possible controls have been applied and the risk is at its lowest score.

If risk materialises despite mitigation (for example: flood defences fail) contingency plans are put in place in order to react to the situation. Contingency plans are also a form of corrective control and can be used when the cost of removing the risk or applying other controls is excessive.

4 RISKS TO VWSE BUSINESS FUNCTIONS FROM CLIMATE CHANGE

Climate change may manifest itself in ways which affect our ability to meet demand such as a reducing supply base, infrastructure issues, and rises in demand. As a business we aim to meet our customers demand with clean and safe drinking water at an acceptable price. The following section outlines the consequences of climate change which could have an effect on our business functions.

Appendix C transfers the issues mentioned in this chapter to a likelihood/severity matrix. This allows for quick identification of our high priority risks as described in Section 3.

4.1 Water Scarcity

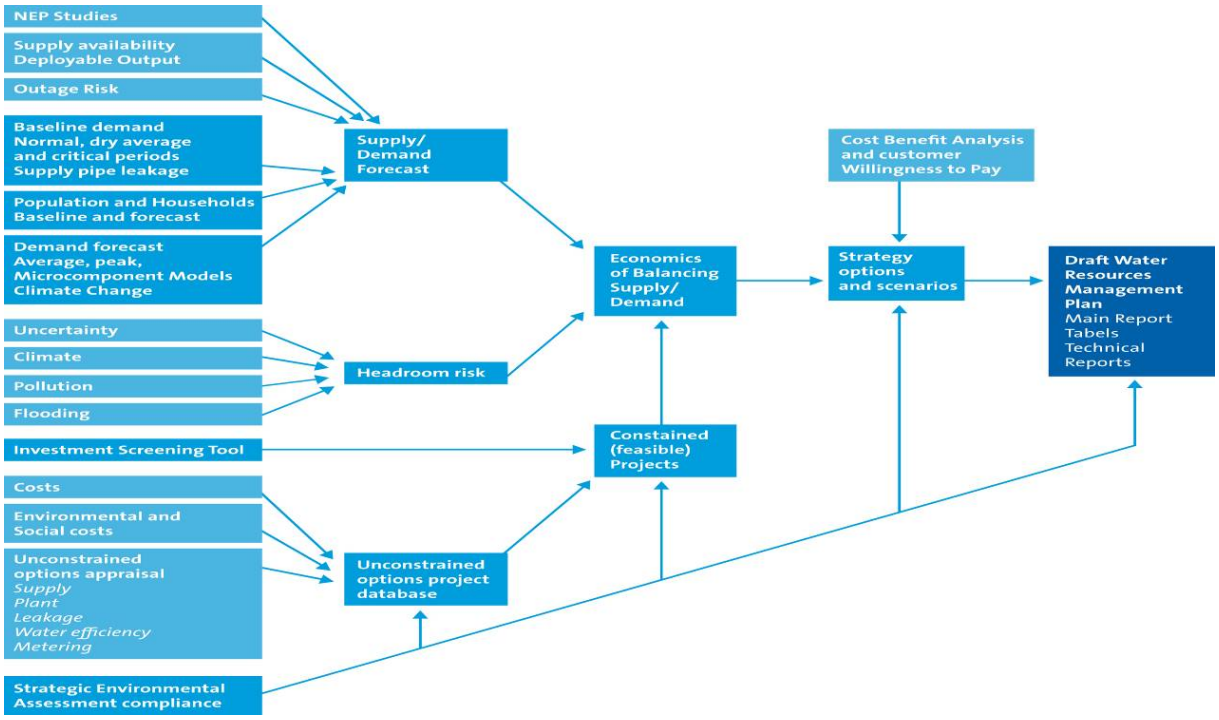
VWSE is relatively resilient to drought with compulsory restriction orders being rare. However a series of dry winters may deplete groundwater supplies and cause problems in meeting a consistently high public demand. UKCIP CP09 projections predict an increase in the frequency of droughts and so proper planning in this subject is taken very seriously. For this reason it is important to have accurate predictions regarding if, and how, water scarcity will affect us.

4.1.1 Summary of Methodology Used

We have based our predictions on the premise that water scarcity is the consequence of water shortage, i.e. that our monitoring data shows a continuous higher level of demand greater than our ability to supply from our groundwater sources and imports to our supply area, for periods greater than very short term isolated peaks. This type of study is undertaken as part of the WRMP process and under continuous review.

Our *Water Resources Management Plan* has a planning horizon of 25 years; but we have also looked beyond that in order to assess the impacts of climate change, (to 2050 and 2080). We have used the UKCP09 findings for weather scenarios throughout the 21st century and have considered the worst case scenarios during our approach.

Figure 4.1.a: Schematic representation of WRMP Studies



To build our Water Resources Management Plan a number of studies have been carried out including forecasts of the amount of water available to meet the demand of our customers. These are combined to assess any actions needed to maintain security of supply. The study elements used are shown in Figure 4.1.a.

Figure 4.1.a demonstrates the scope and quantity of studies that go into our methodology for assessing supply and demand risks. Our approach is informed through years of data and experience and we consider it to be appropriate for use. Findings from the studies are then evaluated and individually weighted by our experienced engineers to generate a well informed and balanced plan. Copies of the technical reports are included on our website[1].

4.1.2 Demand Changes

Added pressure on present and future water resources is imposed by expanding urban environments. We recognise that in our region, further urbanisation is needed for economic growth which generates increases in population and houses. Our plans will need to be both flexible and robust in the longer term to ensure we develop new resources where necessary and, in conjunction with demand management, moderate the demand for water and reduce leakage.

Demand across our region in 25 years will be marginally lower than it is today, through the implementation of demand management measures such as over 95% metered penetration causing an initial fall by 2015, and gradual rises thereafter as population increase starts to consume the efficiency savings from metering. We expect around 27,000 new houses will be built in the next 30 years, across our operating area. Experian's policy based household projection goes as far as to expect a 42% rise in households across the region by 2040, and a corresponding increase in population of 30,000 individuals, a prediction supported by the Environment Agency.

[1] https://southeast.veoliawater.co.uk/

Climate change consequences for demand have been modelled in accordance with the final CC:DEW Climate Change and Demand for Water report prepared by the Stockholm Environment Institute in 2002. Increase in demand is a difficult factor to quantify and this is reflected in the headroom of our predictions. We have allowed for an increase in demand of 1.5% due to climate change. Our headroom considers the uncertainty in our calculations as well as providing a safety margin allowing for flexibility within our operations. We know that increases in temperature cause increases in demand but when combined with our continued water efficiency operations, we are unsure as to its entire effect in terms of future demand over time. Our WRMP work indicates that demand will rise if water efficiency activity is not implemented, and this is likely to be further exacerbated by climate change.

If water efficiency is minimal in implementation or its effects are negligible, demand would outstrip supply late on in the planning horizon and we would need to seek out additional water sources. Investing in new water sources is financially, as well as environmentally costly. As a business we aim to manage our water resources sustainably. By introducing further water efficiency measures across the network we can slow the rate at which demand is increasing in our region and ensure that the effects of climate change do not cause us to fail to meet future water demands. By ensuring that our demand is always less than our supply (through the implementation of additional water efficiency projects whenever is necessary) we are confident that we will meet our future demand for water, while operating our water sources sustainably.

4.1.3 Reduced Surface Water Deployable Output

Veolia Water Southeast does not have any surface water sources within its supply zone. Therefore no changes to supply brought on by climate change have been considered.

4.1.4 Reduced Groundwater Deployable Output

We have 45 operational boreholes distributed across the company's area. Boreholes contribute 100% of our supply, so it is important to have an accurate and robust approach to determining the effect climate change may have.

In preparing our plan for the next 25 years we considered factors likely to influence the amount of groundwater available, such as climate change and pollution. Changing rainfall patterns caused by climate change may reduce the recharge of our underground sources and as already mentioned, increase demand in the summer months at the same time. UKCP09 findings showed that annual precipitation will remain relatively unchanged but will be more intensified during the winter meaning there will be drier summers.

Despite this increased winter rainfall, a major study we undertook for our Water Resources Management Plan to assess the various effects of climate change on our ground water resources predicted that ground water levels may fall. Changes in climate, for instance a longer series of successive dry winters will produce more frequent drought events. We have built an additional provision into our Water Resource Management Plans to allow for these risks.

The overall supply/demand balance over the plan period is shown in Figure 4.1.b and Figure 4.1.c for dry year annual average and critical period in an average year.

Figure 4.1.b: Baseline Supply / Demand Balance – Dry Year Annual Average

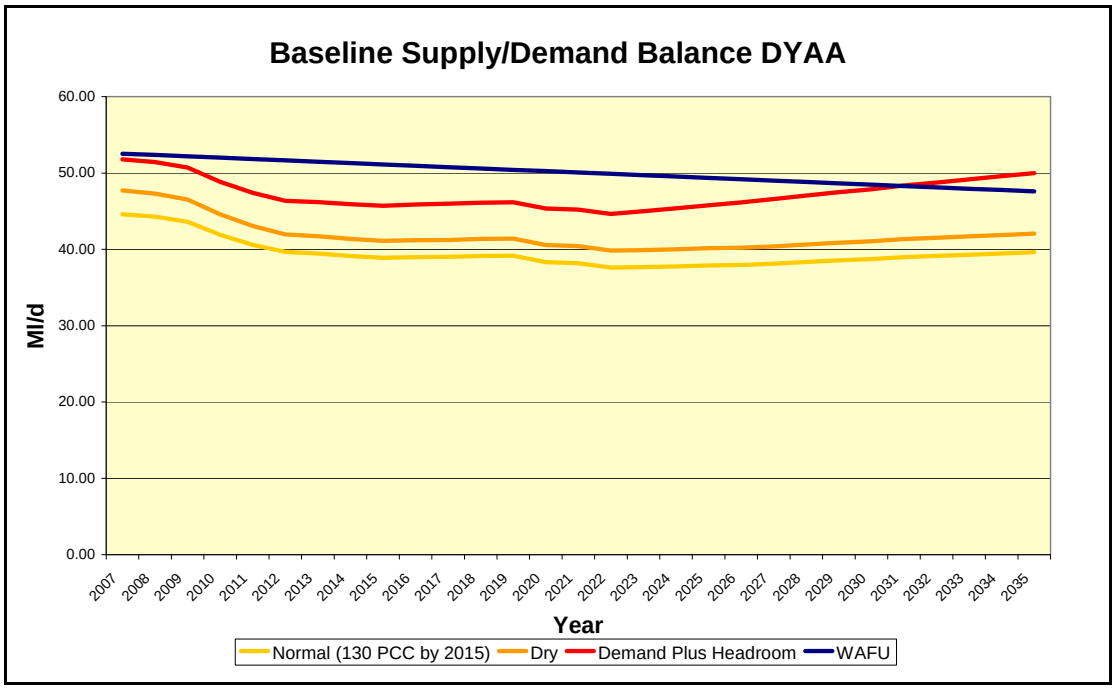
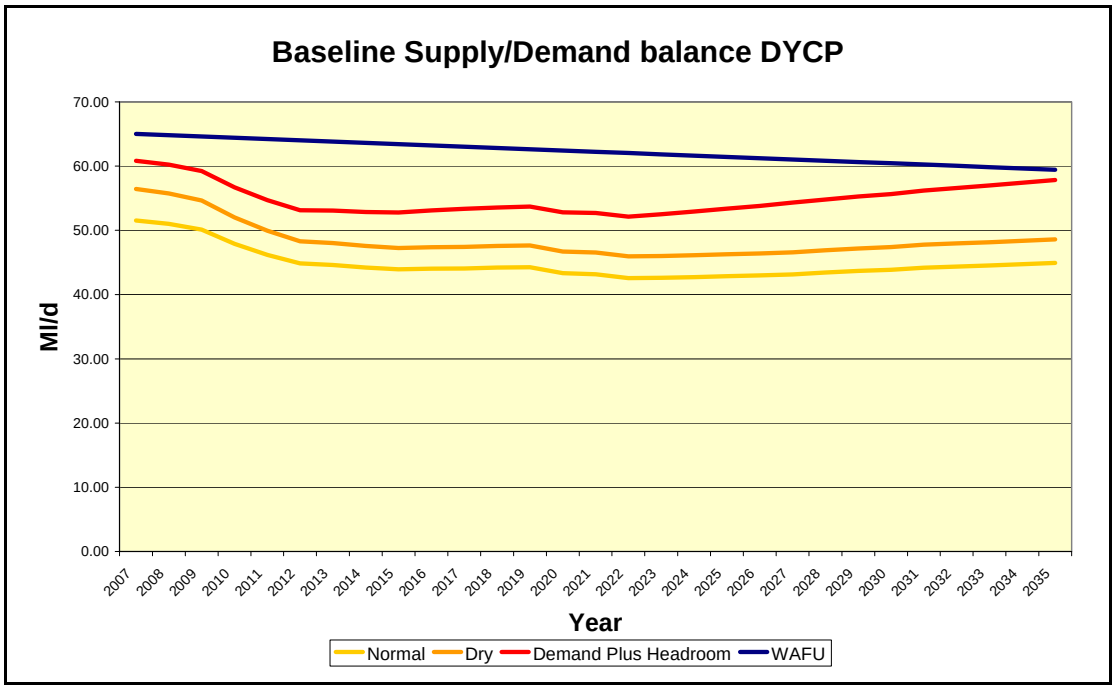


Figure 4.1.c: Baseline Supply / Demand Balance – Dry year critical period



This shows the marginal fall in demand is countered by the slightly larger fall in supply (predicted to be caused by climate change) causing demand (including headroom) to exceed supply in dry years before the end of the planning horizon. This balance needs to be considered in light of the additional water efficiency actions that may be implemented over time to supplement the delivery of supply side activity. This may help to delay the point at which Veolia Water Southeast goes into supply side deficit.

4.1.4.1 Reduction in Groundwater Levels

4.1.4.1.1 Summary of Methodology Used

Our current source yield assessment methodology used to calculate our groundwater levels are based on the earlier approaches outlined in the following reports:

- *A Methodology for the determination of Outputs of Groundwater Sources (UKWIR): Beeson, van Wonderen and Mistear (1995).*
- *NRA R&D Note "Surface Water Yield Assessment" (1995).*

In addition, Veolia Water Southeast has adopted a more rigorous approach to deployable output assessment by:

- Carrying out some determination of the likely impacts of climate change;
- Expressing some degree of uncertainty in the deployable output figures (now considered as part of Headroom assessment).

Modelling of the effects of climate change on groundwater source levels has also been undertaken. We have, in association with Southern Water and South East Water commissioned Atkins (the Atkins Groundwater Report) to undertake a study of the possible consequences of climate change on the groundwater sources in the East Kent area. Atkins used guidance from the *UKWIR CL/04/C* study (ENTEC 2007), and the Environment Agency (2007) and the East Kent Groundwater model, which had been recently developed by Mott MacDonald for the EA and is considered to be the most suitable model for this area.

Forecasts of climate for the 2020s produced a succession of water level fluctuations for the entire modelled area. These water levels were then compared with the calibrated historic base line water levels in nodes where public water supply sources were present to look for additional declines in modelled water levels over those seen in the past.

Findings from our studies contribute to our overall understanding of the effects of climate change and also give an indication of how this could affect our business functions. This information is used to formulate our risk register and enables us to identify appropriate actions. For a detailed account of the assessment methodology, consult our Water Resources Management Plan.

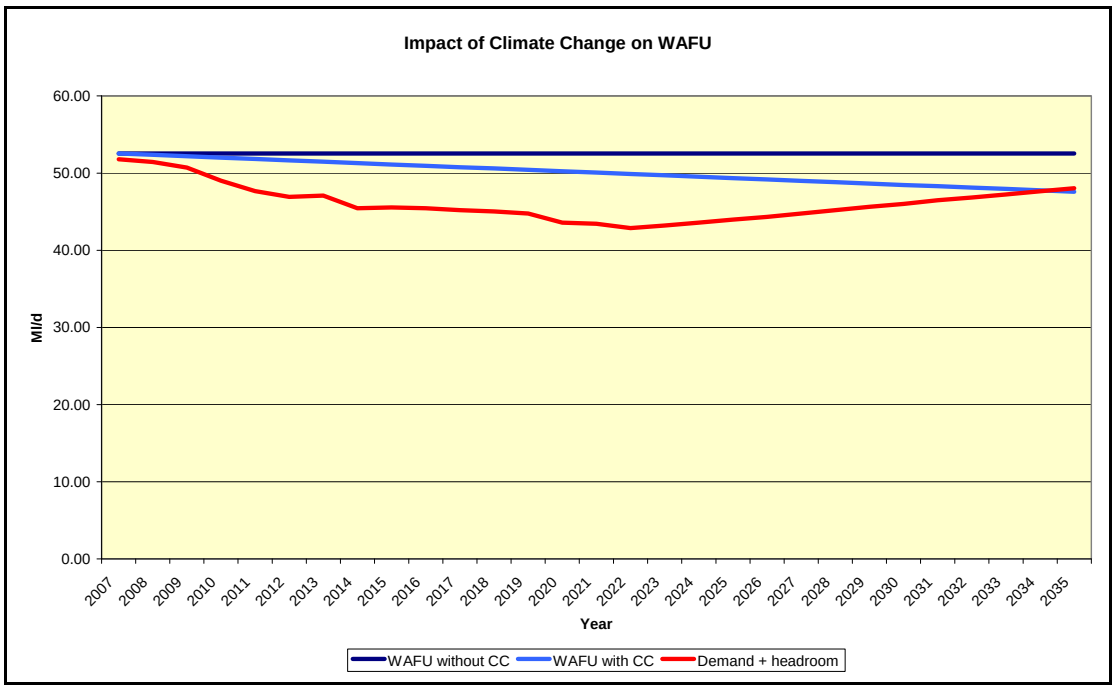
4.1.4.1.2 Potential Impacts of Climate Change

We recognise that climate change may alter the quantity and patterns of precipitation in our region. We consider historical, as well as future predicted rain fall statistics in our water resource planning.

The frequency of these low rainfall events in the past is not necessarily a guide to how they will occur in the future, particularly when climate change is considered. The UKCP09 projections do not show a long term historic decline in overall rainfall patterns, but they do predict more variability, which could lead to more drought conditions. As most climate models indicate wetter winters and drier summers, there should be more winter recharge, thus more groundwater availability than at present. However, variability is also a significant feature of climate change, and not all winters will be higher than average. The increase in variability may make it more likely that an extended sequence of dry winters could occur.

Based on our studies for our Water Resources Management Plan we have allowed for a sustainable reduction in water availability of around 11% by 2035 as a result of climate change, as can be seen in Figure 4.1.d. Other planning documents, for example, the Secretary of State's own Future Water, also suggest that we can expect such reductions over the period.

Figure 4.1.d: Impact of Climate Change on WAFU



Our work for our Water Resources Management Plan shows that if expected reductions in water supply through climate change effects occur, we will not need to develop any new water resources until after 2034. But it takes a long time to plan, get consent for, and build major new sources of water so we need to continue to explore options for resource development.

There is variation in the susceptibility of low flows across our sources so being unable to guarantee the continued use of all of our supply could be a concern. We will undertake adaptive action to ensure that if we do experience drought conditions more regularly, we are able to continue operating until the aquifer is able to recharge.

Extreme events such as these are managed by following our published *Drought Management Plan.* This explains our approach and guides the progressive implementation of measures to support our supply/demand balance.

From experience, we know that our groundwater sources are robust to one dry winter (dry being 75-80% of long term average rainfall). Two such dry winters result in significantly lower groundwater levels and reduced outputs from vulnerable sources and the imposition of flow constraints/augmentation requirements. This is what the current drought Deployable Output (DO) scenario is based on. Three dry winters has not been experienced within the available records for groundwater levels, but has been recorded in rainfall terms in the 1890's.

Analysis of the Atkins Groundwater Report provided a guide to potential future deployable outputs and highlights the vulnerability of individual sources to deeper pumping water levels.

Generally, nodal drought water levels were reduced by between 0.1 and 7.35m as a direct result of climate change. The results of the modelling can be seen in Table 4.1.a.

Table 4.1.a: Effect of climate change on Deployable Output of VWSE Sources

Climate change estimates	Reduction at average	Reduction at peak
Atkins – High impact	15.22 Ml/d	14.31 Ml/d
Atkins – Medium impact	**4.95 Ml/d**	**5.57 Ml/d**
Atkins – Low impact	0.97 Ml/d	0 Ml/d

If the significant lowering of groundwater levels were to occur as predicted in the Atkins Groundwater report, there would be additional effects on other groundwater related wetlands, and even possibly some saline intrusion. The Environment Agency (EA) may find that these impacts on the environment are so severe that they would either wish us to reduce or cease abstraction from some sources. No such comments have been received from the EA, but this action could significantly affect the availability of water to meet customer demands should such reductions be required at a later date.

In the case of the Dungeness gravel aquifer, where no suitable model is available, a different approach was adopted to that used in the Atkins Groundwater Report. In the case of this aquifer, summer rainfall does contribute to recharge as there is very little soil and thus once into the system, rainfall can only leave by lateral transfer to either the sea, lakes or sewer. The exact change in DO cannot be calculated, but this region was considered to be very sensitive. It is therefore likely that changes in precipitation brought about by climate change will have ongoing effects on the Dungeness gravel aquifer. Work is ongoing to collect monitoring data and further conceptual modelling is required to calculate the exact effects of climate change on the Dungeness aquifer.

It is clear as calculated in our Water Resource Management Plan, that deployable output will fall across the region, in part, because of climate change. The levels of reduction however, do not affect the supply / demand balance until late in the planning horizon as Figure 4.1.b and Figure 4.1.c suggest. Constant monitoring of this situation will be necessary to ensure that projections are accurate and that adaptation actions mentioned later in this report remain appropriate. As we have already seen, it is difficult to quantify future demand and so it is important therefore to be able to guarantee supply. As a business, we aim to manage our water resources sustainably. Although over our planning horizon, ground water levels will only fall a small amount due to climate change, a decreasing supply is unsustainable and without our appropriate action, will continue to fall.

If climate projections for variable precipitation are correct, we could experience a greater frequency of drought conditions by the end of our planning horizon. It is important that to reduce the likelihood of increasing compulsory restriction bans from 1 in 10, we must consider adapting our current approach. Our current approach is sufficient for our planning horizon of 25 years, but our evidence shows that our ground water deployable output is susceptible to the effects of climate change and is shrinking whilst demand is increasing creating an unsustainable business model.

4.1.4.2 Saline Intrusion

The Veolia Water Southeast supply area is bounded on its southern eastern side by the English Channel. The process of groundwater abstraction in close proximity to the sea increases the potential that saline intrusion of the Dungeness aquifer could occur, and this potential effect could be amplified through changes to the supply/demand balance caused by the alterations through climate change. As this report has shown, demand will exceed supply near to the end of our planning horizon meaning it will become more and more important to manage water resources sustainably. Recent studies have been undertaken to assess the effects of climate change on the likelihood of saline intrusion.

4.1.4.2.1 Summary of methodology used

Dungeness has been subject to a series of investigations required by the EA as part of its Habitats Directive, to look at the impact of our public water supply abstraction on water levels within the beach. These concluded in AMP3 that there was no effect and therefore the likelihood that abstraction caused saline intrusion was negligible. However, in AMP 4 the EA has indicated that it requires the Company to undertake further work to demonstrate what effect current and possible future operational abstraction patterns would have on the requirements of the Habitats Directive.

Consequently, work is already ongoing investigating these areas. The work seeks to:

- determine the extent and pattern of abstraction that provides protection against saline intrusion as far as possible

- evaluate the medium to long-term sustainability of the aquifer as a groundwater resource in the context of environmental, water quality and climate change considerations

This work has been carried out in addition to groundwater yield assessment studies and modelling as described in the previous section of this report. Consideration of the effects of storm surge that has the potential to cause saline intrusion in the area have also been undertaken, in terms of reducing deployable output from affected areas. Findings from these studies contribute to our overall understanding of the current issues and therefore the potential effects of climate change and how our business functions may be affected.

4.1.4.2.2 Potential Impacts of Climate Change

Storm surge likelihood has been considered for the Dungeness area. UKCP09 predictions suggest that the increased intensity rainfall in winter periods may be a contributing factor in increased storm activity likely to occur in winter when storms are expected to be at their fiercest. Several linked sources close to the coast on the Dungeness Peninsula are at risk of inundation by a high storm surge. The sources supply the surrounding villages and the Dungeness Power Station. The water abstracted from the sources is treated via a reverse osmosis plant. The plant has the capability to remove salts if the sources were polluted with saline water, but has a limited output capacity when saline loading is high.

Therefore additional treatment capacity would need to be installed which would add additional costs through its installation and operation. Our study to assess the potential for storm surge inundation estimated a 1 in 20 year likelihood (i.e. a 5% probability) that DO is reduced from 4.65 Ml/d average and 5.58 Ml/d in the critical period to 1.68 Ml/d and a 95% probability that no impact occurs. This has been considered when evaluating our overall concern of potentially insufficient supply over the longer term.

Clearly the increased variability of future summer / winter precipitation events due to climate change will exacerbate the likelihood of low groundwater levels, while at the same time increased intensity rainfall in winter periods may contribute to storms with greater impacts than previously recorded. The potential for saline intrusion specifically linked to climate change has been identified but this has not been directly quantified at this time. Further modelling of the scale and frequency of storm surges will be undertaken to understand the most suitable adaption measures. This work has not been undertaken at this stage and without it; justification of appropriate adaption methods remains an issue.

4.2 Flood Risk

As mentioned, UKCP09 climate projections point towards a more variable climate with not only an increased chance of drought conditions, but with more intense rainfall patterns also. Projections of increased rainfall are likely to result in higher intensity rainfall events, and longer wet periods. This could give rise to increased flooding, which would have an effect on assets on or near the floodplain. Projections also suggest there could be more surface flooding from rainfall (pluvial flooding) with the corresponding increase in risk to water company assets within many urban areas that are not in the fluvial floodplain.

For this reason, we have devoted a significant amount of time and resources to assessing this issue and preparing our flood defences in line with recommendations made in a number of external reports. The studies showed that like water scarcity, floods have the potential to reduce our ability to meet demand in a number of ways such as contamination of supply, damage/destruction of assets, and restricting access to our sites.

Independent consultants Jacobs found that whilst floods have never been responsible for us failing to meet demand, it would be advisable to proceed with our flood protection programme to guarantee resilience. Without our actions, floods, which are a likely symptom of the CP09 climate projections, could very easily overwhelm the network by damaging physical assets such as treatment works, or by eliminating our access to them all together. See Appendix B6 of our Business Plan for the full Jacobs report.

4.2.1 Summary of Methodology Used

In Ofwat's PR09 methodology paper, *'Setting price limits for 2010-15: Framework and approach*' companies were asked to review the likelihood of damage to their critical assets from flooding and to identify whether further investment is necessary.

Ofwat also commissioned Halcrow to develop an approach to flood risk assessment which we have adopted for studies into flood potential. The approach is outlined in the report *'Asset resilience to flood hazards: Development of an analytical framework'.*

The approach to identifying flood risk at key Company sites is outlined in the following steps:

1. Desk top analysis of identified sites: This considered fluvial, groundwater, coastal and pluvial flooding mechanisms. From this a list of sites potentially "at risk" was developed.
2. From the desk top analysis the quantification of flood risk probabilities was undertaken for identified sites.
3. Site surveys were undertaken for identified sites to assess the site specific conditions in more detail and to identify the scope of flood protection measures required.
4. Detailing of investment scope and cost estimates on a site by site basis.
5. Cost benefit analysis of investment options.

All of our sites were assessed against four flooding mechanisms, *fluvial, groundwater, coastal*, and *pluvial*. The approach for each type of flooding is presented below.

Fluvial Flood Risk Assessment

Identification of sites, and associated structures, exposed to the potential of flooding was assessed as a two stage process:

An initial assessment was carried out by overlaying the Environment Agency 1 in 100 year event and 1 in 1000 year event published flood extents over GIS layers showing the range of Company's water supply structures across the catchment. This refers to the flood water level expected from flood events across the referred to time periods. For example, a 1 in 1000 year event could be expected once every 1000 years and is therefore an extremely rare event. Planning for a flood event of this size is unnecessary and more detailed flood event data would be desirable. However, from this screening process a shortlist was drawn up that identified those sites (and associated structures) that warranted more detailed investigation in order to produce a more accurate assessment of flood risk.

It was originally intended to incorporate more detailed flood mapping for a number of catchments within our region. This would have allowed for studies covering 1 in 20 year flood event, 1 in 100 year flood event, and 1 in 100 + 20% flood event (The 1 in 100 year + 20% flood event allows for the potential impact of climate change as following Environment Agency guidance, 1 in 100year +20% flood events are expected to occur as often as 1 in 100 year events by 2115). Due to a lack of detailed flood mapping in a number of our catchments, an approximate assessment was made on-site to identify structures that could be potentially affected by flooding, including those structures with a known history of past flooding.

Groundwater Flood Risk Assessment

Sites potentially affected by groundwater flooding were identified by overlying our assets GIS layer over the Defra Groundwater Emergence Maps. This series of maps identifies those areas where groundwater is predicted to rise to within 2 m of the ground surface in an unusually wet winter.

Coastal Flood Risk Assessment

Due to our coastal location we face the additional effects posed by rising sea levels and the increased propensity of coastal floods brought on by storm surges. Sites potentially affected by coastal flooding were identified by overlying our assets GIS layer over the EA 1:1000yr undefended coastal flood extents. This flood extent indicates the predicted inundated area assuming no flood defences are in place.

Pluvial Flood Risk Assessment

Sites at risk from Pluvial flooding were assessed from historical operational information, from desk top site assessments and the site visits. This focused on the potential for flooding as a result of run-off from large catchments or adjacent roads in event of significant localised rainfall, which was not shown on flood mapping.

4.2.2 Potential Impacts of Climate Change

Table 4.2.a summarises the findings from our flood studies. It shows that flooding has the potential to affect a number of our sites across our region with varying consequences.

Table 4.2.a: Summary of flood risk to company sites.

Sites Selected for Survey	Flood Level Data Available	Recent Flood History	1:20 yr coastal flood risk	1:100 fluvial flood risk	Ground-water flood risk	Pluvial flood risk
Denge WTW	Yes	No	Yes			
Ottinge WTW	No	Yes		Yes	Yes	
Worlds Wonder WTW	No	No		Yes		
Rakesole WTW	No	Yes		Yes		
Tappington Borehole	No	No		Yes		
Denton Borehole	No	No		Yes		
Broome WTW	No	Yes		Yes		
Lye Oak WTW	No	Yes		Yes		
Standen WPS	No	No				Yes
Stonehall WTW	No	No				Yes
Kingsdown WTW	No	No				Yes
Elms Vale WPS	No	No				Yes
George Gurr WPS	No	No				Yes
Fairways control	No	No	Yes			Yes

The data in Table 4.2.a shows that a number of our sites may be affected by not only fluvial flooding, but coastal flooding too. Analyses of other Veolia catchments where more detailed modelling has been carried out (e.g. Colne valley for Veolia Water Central) has shown that where structures are located well within the 1 in 100 flood extent, such structures are also potentially susceptible to flooding from lower return periods such as 1:20 or even 1:10 events. It is therefore considered conservative to assume a more common flood return period for those assets under this case as Table 4.2.a demonstrates.

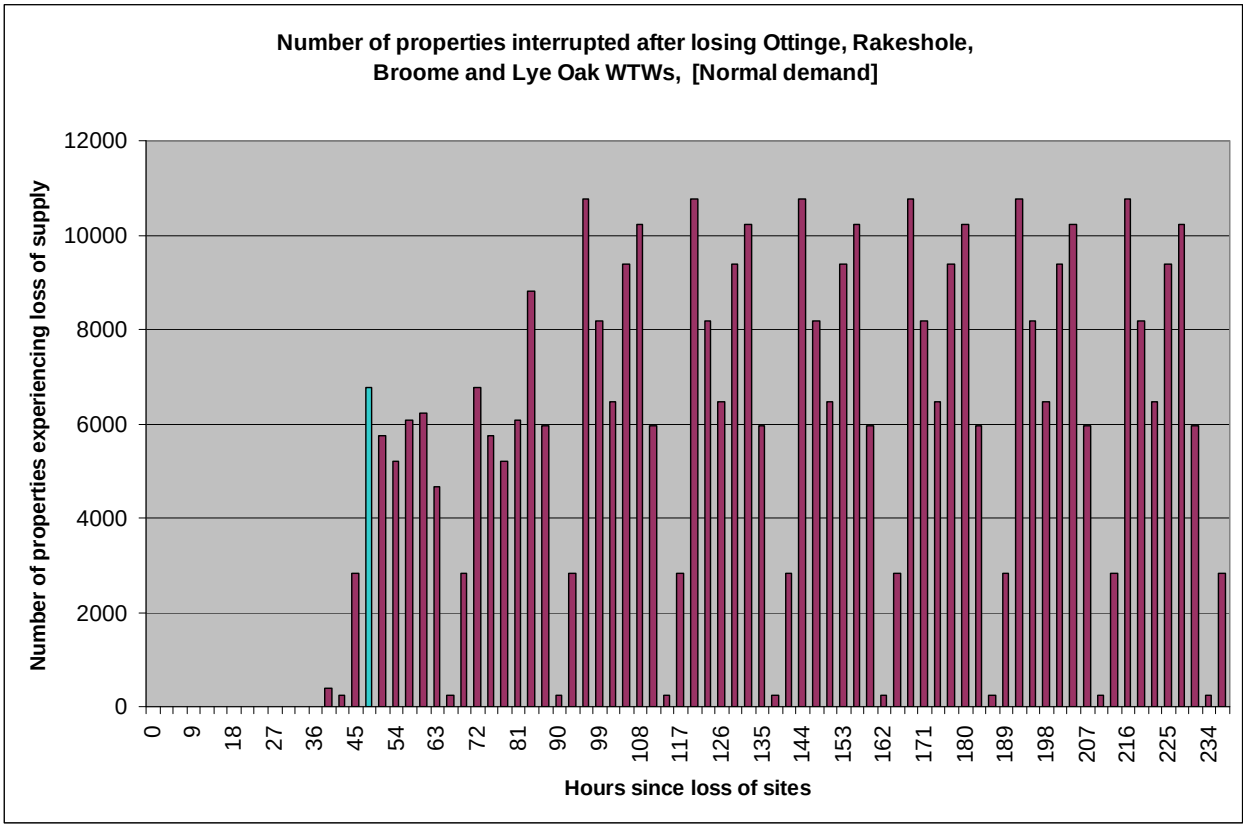
We originally intended to assess flood risk from a return period of 1 in 100 year +20% . To overcome limitations with data, we conducted individual site surveys of the facilities identified in Table 4.2.a to manually assess the consequences of a 1 in 100 year + 20% event. This study identified 8 sites with the potential to be affected by flooding due to the effects of climate change.

The consequence of flooding on any of the identified sites has been assessed as loss of supply. The effect of this loss for customers has been assessed using an environmental model known as MISER, as detailed in the Non-Infrastructure Capital Maintenance business case. The use of MISER is a specific approach which enables the loss of output at specific treatment works to be modelled and the number of properties experiencing loss of supply to be ascertained.

Assessing the loss of any one site on its own, did not result in customers experiencing interruption to supply, however, as our operating area is relatively small and given the proximity of four key sites (Ottinge, Rakeshole, Broome and Lye Oak) in relation to each

other, the consequence of losing all four sites was considered. The results are provided in Figure 4.2.a. While considering the loss of all sites from the same flooding event may be considered unlikely, the effects of climate change could increase this likelihood.

Figure 4.2.a: MISER modelling results for interruptions to supply from loss of Ottinge, Rakesole, Broome and Lye Oak WTWs



From the MISER analysis the number of properties after 48 hours affected by loss of 4 sites, Ottinge WTW (water treatment works), Rakesole WTW, Broome WTW and Lye Oak WTW was assessed as 6,780. Tappington Borehole and Denton boreholes both feed the Rakesole treatment works, thus loss of the treatment works means that neither borehole can be used.

The duration of this flood event was assessed at greater than 24 hours due to the severity of the events and reflected the likelihood that staff would have significant difficulty attending site to dry out equipment and recover operational outputs. Figure 4.2.a shows that a flood event affecting just the 4 sites mentioned could cause a loss of supply to around 11,000 properties. If the UKCP09 projections for climate change are correct we could experience a greater propensity of floods. It is therefore important to ensure that our sites identified to be potentially affected are adapted to continue operating and maintain supply during high level flood events.

We feel that our customers are at low risk to flooding throughout our planning horizon. Although floods at or near our sites are a distinct possibility it is unlikely that these events will cause supply to be lost under present conditions. Resilience will increase further following completion of our proposed flood adaptation programme.

The potential threat to our business operations caused by flooding has been considered in our future planning and work is currently underway to address this risk. However, it is likely

that flooding will pose a greater risk to our sites beyond our planning horizon, when flood events on the scale of 1:100 + 20% flow become as common as 1:100 flow events. For this reason it is currently difficult to financially justify expansive adaptation programmes in our region with regards to flood protection to a level of 1:100 + 20% flow.

This report will address our current and proposed flood adaptation actions later.

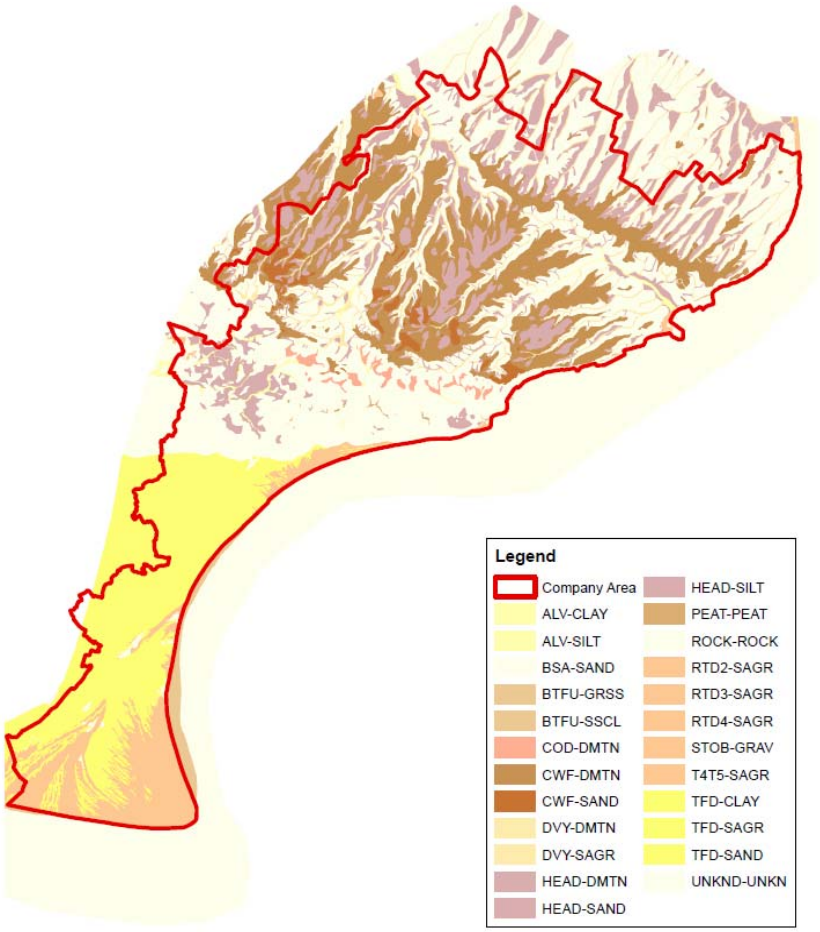
4.3 Reduction in Network Resilience

In order to meet our business aims of meeting demand for water and providing a product which meets quality control standards, we must ensure we provide a reliable network which adheres to regulation. Climate change will not only have consequences for our above ground assets i.e. through flooding, but also affect our below ground assets through more contrasting differences between wet and dry periods accentuating the shrink and swell effect of our region's soil.

4.3.1 Leakage Control

The consequences of climate change are likely to have a detrimental effect on the network, predominantly through amplifying the adverse characteristics of our soil. Drought, freezing and rapid rainfall will lead to unpredictable movement in the ground, directly increasing the number of burst mains and leaks. Figure 4.3.a illustrates the wide range of soils which populate our region. This wide range can make it difficult, if not impossible, to predict leakage with any certainty.

Figure 4.3.a: VWSE region geological identity



We cannot efficiently operate as a business if we are unable to deliver water to our customers due to leakage. Currently, water lost through leakage does not threaten our supply demand balance, but as we have already seen, by the end of our planning horizon we anticipate demand to just exceed supply. It is therefore also important for us to reduce the effects of leakage in order to extend our supply capabilities and increase resilience and flexibility in our operations.

Not only do bursts cause loss of water, but are also financially expensive to repair. We are statutorily obligated to meet leakage targets set by our regulators. Water companies which fail to meet such targets receive adverse publicity and have the potential to receive financial penalties. For these reasons it is important to assess and quantify the likelihood of climate change increasing burst rates.

4.3.1.1 Summary of Methodology Used

Our current approach to leakage is determined by Ofwat and driven by the economic level of leakage (ELL). A least cost plan approach has been used to minimise operating costs in the short term and defer capital investment in the future. We consider achieving an adequate supply/ demand balance as a key part of our overall business strategy.

Our Water Resources Management Plan explains the financial drivers for network leakage. Assessment of the ELL is an important factor in demonstrating to our regulators that we are operating efficiently.

This economic approach to leakage means that we currently replace pipes at a rate which maintains the serviceability of the network.. Controlling leakage is an important activity for us and pipe renewals help us to achieve this. We must continue to work with our regulators to maintain the service we offer our customers.

The potential impacts of climate change have been observed in recent years through drought and flooding. We will need to ensure that both our treatment works and network pipes are resilient to such events. However there are many uncertainties concerning the consequences of the UKCP09 projections for climate change which could affect the assumptions made in predicting future leakage levels. Current methodology for assessing bursts caused by temperature changes is mostly based around expert opinion and historical evidence. Due to the nature of our infrastructure (i.e. pipes of different sizes, ages, materials, and depths laid etc) it is almost impossible to accurately predict the likelihood of bursts for given weather scenarios. Historical analysis shows that bursts increase when temperature decreases and as the UKCP09 projections do not predict any significant drops in temperature, we do not consider climate change to have an affect on bursts in this way. In fact, if mean temperatures increase in the winter, we may experience a reduction of bursts caused by freezing.

4.3.1.2 Potential Impacts of Climate Change

We currently do not have accurate enough data, or computational methods, to predict to what degree weather scenarios will affect our network and so are therefore restricted to expert opinion and historical trends when planning our future approach.

Variable weather patterns as a result of climate change may accentuate our burst rate due to the shrinkage and swelling of our soil. As we experience a more extreme difference between our wet and dry periods, so too may we experience a rise in bursts. It is important that we consider this risk early and work towards quantifying the effect of climate change.

Bursts will become more of a financial concern and also contribute more negatively to the supply demand balance. As this report has shown, our future supply/demand balance is delicate and so efforts must be made to reduce the likelihood of demand outstripping supply. The ELL may be affected to such a degree that the cost of bursts is so great that repair becomes economically unjustifiable and replacement becomes standard procedure. In this way, climate change may affect our financial resilience as more and more resources are diverted to leakage operations. Section 5 explains our proposed adaptation actions in more detail.

5 PROPOSED ADAPTATION ACTIONS

The following section outlines our proposed adaptation actions including the methodology used to ensure the adaptation action is appropriate. Due to the nature of our business, preparation against adverse weather is part of our usual approach and we are already in the advanced stages of many adaptation programmes. For this reason, a description of the work carried out so far is included with the planned works.

Where possible, information has been given explaining how our adaptation work has informed our approach and how further monitoring of risk will take place.

5.1 Adaptation to Water Scarcity

Here at Veolia Water Southeast, we take water efficiency to mean using less water, by using water wisely and reducing water wastage. Managing demand is good for sustainability and avoids the need for any additional impact on the water environment and reduces greenhouse gas emissions through energy saved from pumping. Our Water Resources Management Plan explains that we do not take water efficiency to mean restricting or reducing the use of water appliances (for example by showering less or not watering the lawn at all).

5.1.1 Current Actions

We have a range of current efficiency operations, as outlined in our Water Resources Management Plan and hope to continue our current strong performance in this topic through a number of proposed schemes.

Much of our water efficiency work revolves around influencing user behaviour. We propose to continue to put emphasis on carrying out customer research in order to understand our customer's motivations and water efficiency behaviours. Our findings will be communicated through our strategic partnerships with influencers and policy advisors so that they begin to promote credible and appropriate water efficiency measures. It is hoped that our water efficiency operations will have a lasting effect and help reduce demand therefore increasing resilience in periods of low supply.

Our regulatory authority Ofwat influence our actions on water efficiency. We aim to work closely with them on all our water efficiency schemes and through their guidance are able to form effective cost-benefit analysis of appropriate projects. For more details on our cost benefit analysis methodology, see our Business Plan.

5.1.2 Proposed Action to Adapt to the Effects of Climate Change

Demand in our region is expected to remain approximately level with an initial fall seen as a response to our metering programme before subsequent small rises occur later in the plan period due to the forecast in population growth mentioned previously. We have considered this in our supply/demand analysis as shown in our Water Resources Management Plan, but also consider the effect our water efficiency program will have on individual consumption.

We prefer to use water efficiency for managing demand over developing new sources. Water efficiency projects can be implemented much faster than the creation of new sources and can be targeted at specific socio-economic groups. The projects can also quickly adapt to changing conditions of a regulatory or economic nature, and have the benefit of influencing customer behaviour which acts on the cause of increased demand rather than simply reacting to the increase.

All water efficiency activities require measurement of both the costs and benefits in order to assess effectiveness compared to other supply/demand measures. We will carry out water efficiency activities in accordance with practice guidelines given to us by Ofwat and from the recent UKWIR project; *"Quantification of the Savings, Costs and Benefits of Water Efficiency"*. We are committed to researching new and alternative ways to save water and promote efficiency. Our research is a direct benefit to not only ourselves, but the industry as a whole.

5.1.2.1 Education

We plan to extend the information and education service we provide to all our customers, domestic and commercial. We will encourage customers to use tap water efficiently in the home by providing them with more information on the availability and use of water efficient devices, which can be fitted into either new or existing homes. We know that 25% of the homes in our region will be refurbished over the next 25 years, so there is considerable scope to retrofit water efficient devices and appliances helping to make water efficiency part of everyone's lives.

Our proposed educational water efficiency schemes are explained in more detail on our website [2] and in the Water Resources Management Plan.

5.1.2.2 Water Tariffs

Between 2010 and 2015 we intend to continue carrying out trials of new methods of charging for water thus developing the Lydd tariff trial we already have underway. This is a topic which is currently being explored but we are currently unable to quantify to what extent this will reduce load on our supply/demand balance. This option is explored in more detail in our Water Resources Management Plan.

5.1.2.3 Metering

Metering is proven to reduce demand with average consumption for metered customers in our region equating to around 133litres/day compared to 163litres/day for unmetered customers. Metering educates the customer on their water consumption and raises awareness of excessive use. It is in the customer's best interest to lower their demand when metered and so therefore we expect a highly metered population to be more water efficient than unmetered and therefore reduce the strain on our supply/demand balance. Metering also facilitates monitoring for leakage in our supply zones and proportion likely leak locations between our network and leakage that is the responsibility of the customer.

We have made good progress in reaching at least 90% meter penetration in our region, and will continue to reach our target of 96%. This has allowed us to measure usage and patterns of usage more accurately, allowing us to manage demand more effectively. Meters also allow us to charge on a pay-as-you-take basis, which the majority of customers believe is a fairer basis for charging. Metering will allow us to not only reduce demand but to provide the service our customers want.

We will continue to switch customers to a meter based on a zonal metering method. Metering in this way means we can reduce the cost of installation. Our strategy, as explained in our Water Resources Management Plan, means we aim to complete around 96% of meter installations by 2012. The remaining 4% of properties are considered to have complex

[2] https://southeast.veoliawater.co.uk/

plumbing issues such that installation of a meter is particularly difficult or inappropriate at this time.

As with all water resources projects, monitoring will take place periodically for input to our Water Resources Management Plan. By adopting our water efficiency approach in the future with compulsory metering, we can potentially reduce demand and therefore not have to exploit new sources with additional adverse ecological impacts.

5.1.2.4 Water Efficiency Operations

In its publication *Future Water*, Defra announced an aspiration to achieve an average per capita consumption (PCC) of 130 litres/day national average by 2030 for our metered population.

We co-ordinate and manage our water efficiency programme through our Water Efficiency Programme Manager and we will establish a framework for setting project objectives and monitoring performance against those objectives in terms of activities, costs and water volume saved. This will ensure that water efficiency is closely aligned with the regulatory process and we are successful in exceeding the 130l/d Defra target and towards our own aspirational target of metered PCC of 120l/d by 2015.

We will also continue to participate in such groups as the Water UK Water Efficiency Network, The National Water Conservation Group and the Watersave network. We will also work closely with our regulators as well as industry organisations such as Waterwise.

Support of industry and academic research and development groups is fundamental in order to understand the issues involved in promoting water efficiency nationally on a larger scale. This also benefits the sharing of information and best practice throughout the industry and associated parties.

We will, as an environmental measure, lobby for change in building regulations and in the regulations governing domestic appliances and their installation; we will call for tighter regulation on equipment and on the adoption of measures to adapt to climate change.

Our regulatory requirements involve continuously updating our relevant Plans, and we feel that this is the most appropriate manner in which to monitor progress in this sector. We recognise that demand increases are a risk and it is worth noting that many water efficiency activities are already in operation. Our approach to this topic is one of continuous adaptation and we feel that our response framework is currently well prepared to evolve to new challenges or to regulatory requirements.

5.1.2.5 Efficient Management of Supply

Through the promotion of demand management and water efficiency activity, we have not needed to introduce new sources of supply within our planning horizon. However, we intend to consider the efficient management of our existing sources, through several source studies and through continuous liaison with our environmental regulator to review source abstraction limits and licence conditions.

These studies and source optimisation schemes will, combined with our demand management policies help us maintain our excellent position within the industry and allow us to adapt now to climate change. We will ensure we remain competitive by consistently measuring our performance against other water companies in the Southeast of England

using audited and published data. We will seek to challenge and improve upon previously set targets on an annual basis to continuously improve when compared to previous years.

Through our periodic Plans we will monitor progress of all water management projects against supply projections. In this way we will be able to periodically assess the security of our supply / demand balance and reduce the likelihood of experiencing any water scarcity. This will also allow us to communicate our progress to not only our regulators but internally and to our stakeholders. We will also be able to periodically review our adaptation measures and change them if necessary.

5.2 Adaptation to Flood Risk

Flooding has consequences for not only our physical assets, but to the quality of the water we supply. We take the possibility of increased flood propensity very seriously and plan accordingly. Our flood defences need constant updating to remain effective but we are also reliant on the Environment Agency to implement flood protection measures for interdependent assets. These are sites and facilities not belonging to us but of consequence to our operations, i.e. around power generation facilities etc. For example, flood levels may not be high enough to cause our pumping and treatment works to shut down, but if power generation facilities in the region are not adequately prepared, we may lose power and be unable to operate.

As this report has mentioned, our customers are at a low risk to the effects of flooding on our facilities. Beyond our planning horizon we expect to see this risk rise but at present, it is difficult to justify expensive adaptation actions to prepare for climate change flood events of 1 in 100 + 20% flow.

Using data collected through our MISER modelling we were able to calculate the cost benefits from adapting now to certain levels of flood risk. Table 5.2.a outlines the perceived financial benefit from adapting to flood risks. The benefits coming from assuming that all sites are exposed to a 1 in 10 risk of flooding are very high (£162m) which is overstating the existing likelihood. However, even when this is scaled down to 1 in 50 year event the proposed investment is still shown to be cost beneficial to £10m.

Table 5.2.a: CBA Results for flood protection investment

Scheme Title	Whole Life Cost, £k	Whole Life Benefit, £k	Net NPV, (WLB less WLC) £k
Flood risk at 1 in 10	267	162,798	162,531
Flood risk at 1 in 20	267	41,670	41,403
Flood risk at 1 in 50	267	10,414	10,148

Table 5.2.a financially justifies flood adaptation actions providing flood events on a scale large enough to disrupt supply occur as often as once every 50 years.

5.2.1 Current Actions

Through on site surveys, we have determined the designs and costs for physical mitigation measures. Each site, because of its unique layout and topography requires a tailored solution. However the protection measures fall into generic categories. These are listed below:

- *Bunds* – Where it is more economic to protect a group of assets, rather than multiple single assets then a bund is the preferred solution. With any bunded solution comes the additional requirement for sealing, drainage and access.

- *Doors* – Where flood levels are not excessive and assets can be protected within a building, then removable 'stop plates' across doors have been used. Although these will be stored by each door, they will need to be exercised and deployed upon warning of a flood. These procedures will form part of the emergency plan and maintenance programme.

- *Ducts* – To maintain water tightness all ducts carrying cable, pipes etc must be sealed. These will be secured by inspection and the use of expanding foams.

- *Pumps* – Bunded areas will require a new sump pump system and automatic controls. Where sump pumps already exist for operational purposes, these will be replaced with larger pumps where appropriate.

- *Raise* – Where specific plant can be raised above anticipated flood levels without effecting its operation then raising is the assumed solution. Plant will not generally be waterproofed to a submersible rating to enable it to operate underwater. Most of the plant recommended for raising are our electrical transformers.

- *Raise electrical equipment* – As above but applied to plant owned by the electrical supply company.

- *Seal wells* – Some boreholes were found to have openings or seals not in place and that require resealing.

- *Access* – Where bunds are used, access is impeded so ramps have been provided in the designs.

- *Minor items* – including sufficient stocks of waders and sandbags.

We have worked with our energy suppliers and where they have advised there could be possible failures caused by flooding of their plant, fixed standby generators have been included in the designs. Access to some sites during flooding has proved difficult to achieve in the past so 'waterproofed' vehicles and inflatable boats have been included.

5.2.2 Proposed Action To Adapt to the Effects of Climate Change

Independent consultants Jacobs were commissioned to produce recommendations for protecting the assets in our region from flooding. Their recommendations are reproduced in this section.

The first solution considered was to raise any item of equipment which might be below the projected flood level. Whilst this was initially thought to be the easiest and cheapest solution it became apparent that this was not necessarily the best choice.

Whilst it was relatively easy to relocate small items of electrical equipment, when it came to items of mechanical equipment such as pumps it became quite an expensive exercise. Technically it was also problematic as pumps in particular were located in chambers or basements. Pumps are not seriously affected by immersion in flood water. However, should it occur, grease in bearings could become contaminated which would require as a minimum the bearing to be stripped and cleaned before putting back into service. In some instances, where the ingress of flood water cannot be prevented without a major design change, then this option has to be accepted.

Preventing the ingress of water into buildings has been considered as the best option on many of the sites where individual buildings may be affected. It is suggested that stop plates be installed at entrance doors. These can either be of aluminium or a composite material located in a steel frame mounted in the entrance and fixed and sealed to the brickwork. It is expected that such a plate could be used for water depths of up to 400mm. The plate would be provided with a rubber seal.

The only problem with using this method of flood prevention is that some warning is required of impending floods, in order that the plates could be fitted. For facilities where regular access is not required then the plates could be left in place.

Where stop plates are fitted, particularly where there are basements or chambers involved then higher capacity drainage pumps and flood alarms are recommended to deal with any leakage past the stop plates.

Where flood levels of less than 150mm are expected, then permanent kerbs are proposed. In some locations where surface water flooding might affect sites, then walls or bunds have been considered to divert potential flood waters away from the site. These may be subject to local planning approval or EA approval.

We are confident that the proposed solution, based on site specific survey of the sites affected provide a robust assessment of risk and also project scope, and that the cost estimates are reliable. We are confident that this solution will reduce the likelihood of flooding affecting our customers and will provide resiliency against any increase in flood propensity brought on by climate change.

Our cost benefit analysis results and sensitivity analysis provide clear evidence that the proposed flood protection investment is cost beneficial. Also, the proposed investment is small when considered against the benefits to customers from providing reliable supplies of water even during extreme flood events. Therefore, we are confident that these proposals represent value for money for customers.

5.3 Improving Network Resilience

An important consideration for infrastructure industries is the maintenance of physical assets and how climate change may have an effect. We maintain over 1000km of pipes over our 420km^2 supply area and invest heavily in continual improvement of our network.

Leakage reduction has been a significant priority for us in order to contain the demand for water and to allow more water to be available for our customers. The UKCP09 projections for climate change could negatively affect our supply demand balance, and we expect to have to manage a slight supply demand deficit before the end of our planning horizon. Mending a leak increases supply and reduces demand. Despite our enormous progress achieved to contain leakage, we plan to keep leakage containment and reduction as a key priority for the company over the long term.

This report has highlighted the importance of demand management operations in the effort to reduce the impact from potential water shortages in the future. Leakage targets are legally binding and highly publicised. Water companies which fail to meet such targets can be served with financial penalties but crucially, when looked at in the context of climate change, this places unnecessary strain on the delicate supply/demand balance.

5.3.1 Current Actions

Our current strategy consists of two parts: pressure reduction and find-and-fix. With regard to the latter, we have invested in new technology and supplemented our Leakage Technicians with additional resources if leakage breakouts cannot be controlled. Currently, we are divided into 14 hydraulic zones, which in some cases are made up of a number of sub-zones. We currently produce a weekly leakage report which is a mixture of flow measurements from zones e.g. reservoir outlet meter and flow from District Metered Areas (DMA) meters. The process used to calculate this is detailed in our Plans.

Approximately half of the properties in our supply area are subject to pressure control. There are 124 pressure reducing valves (PRVs) installed across the supply area. Approximately, 2/3 of these PRVs are operating in order to reduce pressure to properties which can help to reduce leakage. The rest are used as control at zonal transfer points or emergency transfers.

With regards to our find-and-fix strategy, the regulatory framework promotes repairs on the network to the point that repairing a leak or series of leaks costs no more than developing a new water source. In current industry terms, this is the Economic Level of Leakage (ELL); it is a consistent approach throughout the water industry and will continue to drive our work. We feel that with our increased research in this area, and the development of our network modelling capabilities, leakage levels will be kept at a respectable level in the future and will remain resilient to the effects of climate change.

Despite this, we will, over the next 25 years, have to make sure that in dealing with issues of supply and demand, bursts do not cause leakage levels to rise above the ELL. The network that we have is the legacy of previous generations; we have to make sure that over the next 25 years the network is renewed, maintained, and passed on in good working order. As experience proves, our older pipes in the network are extremely prone to bursts which cause large amounts of wasted water, as well as energy costs associated with finding and repairing leaks.

5.3.2 Proposed Action to Adapt to the Effects of Climate Change

We propose to adopt the same leakage strategy as in the AMP4 period which consists of reducing leakage by 0.1 Ml/d every year, over the 5-year regulatory period. We aim to achieve a leakage level of 7.5Ml/day by 2015. This target would be well below the ELL and the SELL for the majority of our supply area. This leakage level is achievable and would not place too much strain on our supply/demand balance which as we have seen, is very likely to be adversely affected by the effects of climate change.

We are yet to develop agreed upon adaptation actions with our regulators beyond 2015 due to the number of uncertainties associated with forecasting and calculating the physical effect of climate change on burst rates. In order to overcome this, sufficient headroom is required in abstraction licences and operational plant to accommodate demand when leakage outbreaks occur and are brought under control. It remains important to engage customers in identifying leaks that we might not be aware of, so saving water and mitigating damage.

With the aid of new technology, greater investment, and better and faster information, we will be able to respond more efficiently to leaks identified by customers. However, customers may need to be encouraged to see beyond the leaking water main to realise that if we tackle every leak in the future by applying a standard beyond that of the Economic Level of Leakage, then we will have to increase water charges. This is something which the industry will need to cooperate on in the future with it's regulators.

It is possible in the future that demand is so high, and tolerance for leakage so low, that guaranteeing supply to our customers will be seen as more important than maintaining the ELL, and leakage may then be addressed irrespective of cost to the company and to the customer. It is not yet known if climate change will impact on our water resources to this degree in the future but as we continually and diligently monitor leakage, we will know well in advance if this is likely to occur.

Our Water Resources Management Plan explains in detail that we know broadly that the equivalent of around 15litres/property/day in leakage takes place on our customers' property. Metering at the boundary of a customer's property helps our customers identify leakage and encourages them to take action to have repairs done, as they pay for the water that is lost from their pipes. We remain concerned that savings in supply pipe leakage will be difficult to achieve as the cost of repair, which is the responsibility of the customers, may be high compared to the values of water lost. If customers do not repair leaks at a higher rate than they arise, then the average rate of supply pipe leakage will increase over time.

We will continue to renew our mains pipes at the current rate (1 in 200 years replacement) or higher where this can be justified to our economic regulator, Ofwat. We will work with Ofwat on a programme to replace communication pipes (which run between the mains and the customer's property) at the same time as mains are renewed. We will work with the water industry on projects to understand the implications for climate change on burst rates and hence renewal rates.

Environmental accounting and climate change will alter the risk-based and historical approaches to the way we renew pipes and plant during the next 25 years. We will need to calculate and show an appropriate rate of renewal in the future together with an appropriate strategy for mains repairs. In essence, environmental accounting will change the point at which, instead of deciding to repair failing pipes, we will renew the water main along its entire length.

6 UNCERTAINTIES

As the recent report by PricewaterhouseCoopers LLP (*Adapting to Climate Change in the Infrastructure Sectors: Maintaining robust and resilient infrastructure systems in the energy, transport, water and ICT sectors*) highlights that the water industry is generally well informed on the physical effects of climate change. We are considered one of the leading sectors in preparing for, and adapting to, climate change and believe that we are adequately aware of the consequences and appropriate actions needed. However, there are many aspects of climate change adaptation beyond our control which remain unexplored and areas in which uncertainties exist.

This report has outlined the uncertainties in many of our approaches and risk assessment methodologies and explains, where known, the doubt in our assumptions. We are in a position to cooperate and work with other water companies in the UK in order to improve our research and evidence base. However, there are a number of other aspects which we as a sector require more information on if we are to develop a completely accurate adaptation plan.

Uncertainty should not be a reason for inaction. Our adaptive management allows for adjustments, as additional and better information becomes available. Adaptive management requires continuous feedback and adjustments based on the information provided by our monitoring networks.

6.1 Legal and Regulatory Uncertainties

The evolution of the structure and shape of water regulation over the next 25 years is difficult to predict. We hope for new approaches, including more co and self-regulation, greater regard for variations in risk, increased regulatory consistency and long-term clarity, and less micro-management by regulators. We hope to work closer with our financial regulator Ofwat, in order to reduce the adverse threat of uncertainty in the way our industry is regulated in the future. We hope that by working together with our regulators towards a unifying goal of adaptation, we will be able to overcome barriers posed by our regulators and introduce adaptation programmes in the best interests of ourselves and our stakeholders.

In assessing risks and developing our plan for adaptation we have made the assumptions mentioned in this report. We have worked on the basis that legal, financial, and regulatory restrictions placed on us will not change beyond the parameters discussed in our Business Plan and Water Resources Management Plan. Where we foresee a future difference to current practice we have included this in our planning. Unfortunately, there is very little else that can be done to mitigate the uncertainties arising through regulatory, financial, and legal changes throughout our planning horizon, but through our constant monitoring and evaluation of our approach (in the form of our Plans) we can ensure these uncertainties are addressed when information becomes available.

6.2 Data Reliability

Data used during our risk assessments as well as for our proposed adaptation programmes include a certain degree of uncertainty. With specific regards to our supply/demand balance this has been modelled in our headroom and explained in more detail in the relevant sections of our Water Resources Management Plan. For example, within our area, reliable groundwater models do not exist for the Dungeness aquifer, and so do not allow us to analyse the effects of climate change on some parts of our supply area.

We have developed our adaptation program to be flexible in order for uncertainties in our risk assessment to be accommodated. With specific regards to our flood adaptation program, we have improved resilience despite having never lost supply due to an extreme flood event. We would be able to produce more accurate and therefore more effective adaptation programs if we could be guaranteed accurate and reliable data.

Although we are not alone in using the external data sets as detailed in our Water Resources Management Plan, we do recognise that their reliability and accuracy is not guaranteed. With more accurate data we may arrive at different conclusions which force us to alter our adaptation program. We are statutorily obliged to produce updated Plans ever 5 years and so through this mechanism we are able to constantly monitor up to date published data and re-evaluate our risks due to climate change.

We are confident that data used in our planning is the most accurate available and that our proposed adaptation actions are appropriate. We are able to maintain our level of service to our customers but will work with our regulators to ensure this. Our Plans are subject to review and so are confident that any assumptions made in our planning are approved by our regulators to ensure our customers receive the best possible service.

6.3 Water Quality

As a business, we are regulated by not only Ofwat but also by the Drinking Water Inspectorate (DWI) who monitor the quality of water in our supply. Water companies which fail to meet quality standards can face legal action, financial penalties and additional costs associated with the work to correct the fault. Water quality is a serious issue with many water borne illnesses being potentially life threatening.

We are unable to function as a business unless we can provide water which meets quality control standards. Contamination of supply can also affect the aesthetic standard of our water reducing customer's confidence in our ability to provide a safe product.

We work diligently to ensure our product is of the highest quality and have an exceptional safety record. However, there are many unknowns currently with the precise effects of climate change on our water quality.

We understand that higher water temperatures and changes in the timing, intensity, and duration of precipitation can affect water quality but cannot effectively quantify the effect climate change may have. Higher temperatures reduce dissolved oxygen levels, which can have an effect on aquatic life. Where stream flow and surface water levels fall, there will be less dilution of pollutants; however, the IPCC point out that increased frequency and intensity of rainfall will produce more pollution and sedimentation due to runoff.

Water UK, in their summary of how the water industry needs to adapt (*Water UK: How the Water Industry is Adapting to Climate Change, Dec 2008)*, confirm that lower river flows will reduce the dilution of wastewater effluent. We may need additional treatment to meet higher standards, which are likely to be achievable only by using energy-intensive processes, with all that means for greenhouse gas emissions. Colour and odour problems will result from higher temperatures and more intense rainfall events.

The IPCC continue to describe how flood magnitudes and frequencies will very likely increase in most regions, mainly as a result of increased precipitation intensity and variability. Flooding can affect water quality, as large volumes of water can transport contaminants into water bodies and also overload storm and wastewater systems.

A UKWIR report, *Climate Change Implications for Water Treatment,* due to be published in February 2011, will use baseline and future projections of water quality simulated using the following models:

- SIMCAT (a river water quality model developed by the Environment Agency)
- ILC (Integrated Lake and Catchment model, able of simulating both river and lake water quality)
- INCA (Integrated Nitrogen model for multiple source assessment in Catchments)

Using the findings of this report we will begin to understand the consequences of climate change on water quality and plan effectively for future effects. At present we cannot say with any certainty how much of a risk climate change is to our product quality.

In the future we hope to be able to guarantee safe clean drinking water regardless of any consequences of climate change, therefore the uncertainty of our capacity to supply a potable supply is of high concern and will need to be highlighted in future projects. We currently do not know enough to generate specific adaptation actions but will continue to work across the industry to research this topic.

6.4 Effects of Climate Change

We have developed our adaptation program in line with current identified consequences however many of the actual physical effects of climate change remain unknown. We have used the UKCP09 projections and are confident that there will be changes in weather and climate but it is impossible to accurately predict what this changing weather will be, and to what degree it will affect business operations. Due to the enormous quantities of unknowns in this area, we see our safest course of action at present is to increase resilience across large areas of the business where potential consequences of climate change have been identified so that we will be able to adapt in the future when effects become certainties.

For example, we have assessed the likelihood of, and planned for both drought and flooding as well as for increased temperatures and decreased temperatures. The UKCP09 projections are the most reliable data sets with regard to climate predictions in our area, but these will need constant monitoring and updating to ensure our periodic Plans remain accurate.

It is also almost impossible to accurately differentiate between changing weather patterns and behaviours, and consequences which are as a direct result of climate change. Variable weather may be a possible symptom of climate change but it is unknown to what extent it will impact on the business functions of VWSE.

Years of data will help us to prove that weather events such as floods and droughts are becoming more common because of climate change, and would not have just occurred anyway. Being able to clearly identify the risks due to climate change alone will also allow us to assign an associated financial cost. This will allow us to justify our operations to not only our economic regulator but to our customers as well.

We feel that by considering the worst case scenarios detailed in the UKCP09 projections, we will be adequately prepared should discrepancies in the data emerge. We may find that climate change effects that we had previously not considered may bring new consequences for our operations, or identified effects may develop into more serious issues. We will be in a position to adapt having already deeply embedded a high level of resilience in our company

operations. Our risk assessment methodologies and plans for adaptation are flexible and we believe that despite being aware of potentially inaccurate data, feel that we are adequately prepared.

Our current risk assessment methodology considers all effects of changing weather and not just climate change independently. This approach has so far proved effective in ensuring we fulfil our business functions and remain a leading organisation in the water industry. This report has justified our regulator's and our own confidence in our planning approach but it may become apparent in the future that this requires adapting and a more climate change focussed methodology is necessary.

6.5 Risks to Administrative Operations

Like any organisation, we need to ensure that we have the facilities and systems in place to support our activities. We also have a legal requirement to be able to deliver certain critical services at all times, such as emergency provisions for water. To do this we need appropriate buildings, equipment and vehicles and relevant protocols to safeguard our staff and stakeholders.

Our current risk assessment methodology assesses the effect weather may have on our operational capacities. Adverse weather conditions not only create a dangerous working environment but are recognised to reduce work output. We must comply with our duties under Regulation 3 of the Management of Health and Safety at Work Regulations 1999.

We do not currently have a set methodology specifically designed towards assessing how climate change may affect our operational capabilities in the future. However we make use of expert analysis of published reports and historical precedent to ensure our administrative functions remain resilient.

Important industries to our administrative functions, such as telecommunications, transport and energy transmission, are due to publish their adaptation reports throughout the reporting process. These documents will allow us to make informed decisions on the quantifiable risk to our business due to climate change.

Power failures are a distinct possible effect of climate change; without power, our administrative capabilities will be limited. Following the publication of the adaptation reports from the energy sector, we will be able to more accurately quantify how our administrative functions will be affected by energy failure.

Due to the nature of our business, many of our operational sites are in rural areas and so adverse weather conditions may hamper our efforts to access assets. Access to urban facilities, such as our head office, may also become more difficult for staff. PricewaterhouseCoopers LLP sector summary on transport identifies 80 highways agency activities which may be at risk of climate change, and points towards a future where the reliability of our roads network is not guaranteed. Rail connections are also at risk according to the report, with particular mention made to the effect of flooding. We will have to re-evaluate this issue following the publication of the transport sector adaptation reports.

Our business is heavily reliant on information and communication technology to help us monitor, and maintain our network. The PricewaterhouseCoopers LLP report states that due to the nature of the communications industry, long term planning for climate change is not a priority. However, there is an overall recognition that many communications infrastructure assets are exposed to weather related disruption. The dependence of many other sectors on telecommunications also means that extreme weather events could place strains on the

capacity of the networks. The exact nature of this risk will become more apparent following publication of adaptation reports from this sector.

To help ensure we remain fully operational we have recently introduced flexible working hours and facilitate our staff members to work at home. This will help our staff continue to work in the event of adverse weather conditions and ensure our service to our customers remains unaffected.

7 BARRIERS TO ADAPTATION

7.1 Regulation and Legislation

We expect the legal and regulatory requirements which we meet to become more onerous. This is not simply a question of requirements in respect of drinking water. We expect new national and international requirements to mitigate climate change, implying limitations on carbon emissions. The form that new legal requirements will take is currently unknown. For example, recent changes in the Carbon Reduction Commitment (CRC) have altered the way we include carbon emissions in our financial approach.

Limitations on abstraction of water for public supply from the Environment Agency are likely to become more stringent, in part as a result of progressive tightening under the Water Framework Directive. It is worth noting, however, that our adaptation program is only appropriate under currently advised sustainability reductions up to 2015 and we have been prevented from including a quantum of wider resource loss post 2015 in our long term planning, creating an amount of uncertainty. This uncertainty has been modelled in our headroom and we feel that we are in good position to monitor and re-assess this situation through publication of our Water Resources Management Plan.

7.2 Resources

Some of the adaptation activities involve making high cost investments today to adapt to impacts that may not be realised within the typical 25 year planning horizon. To a large extent, the periodic nature of the 5 year price review process, within the context of a 25-year horizon, lends itself to a phased response to adaptation. In theory this is broadly consistent with prioritising investments, and should lead to the adoption of a strategy which avoids large commitments during periods of uncertainties by offering the flexibility to make deferred decisions.

In practice when set against the criteria of value for money, Ofwat need to consider the impact on customers' bills and consumers' willingness to pay. Climate change adaptation is not considered in our customer's willingness to pay studies and for this reason it may be difficult to justify these investments to Ofwat. To overcome this, we will continue to work closely with other water companies and organisations, regulators, and our customers in order to ensure that Ofwat are acting in our customer's best interests.

We will need years of experience to form an effective methodology for choosing investments but we will also need to work closely with the industry to achieve this. Ofwat have been pushing for a more transparent and considerate investment approach and it is hoped that the financial implications of climate change will motivate our industry to improve in this topic.

7.3 Knowledge

Uncertainties associated with the UKCP09 projections and with other data mentioned in this report may make development of effective adaptation strategies difficult. In order to retain investor confidence to justify large scale investments, and to be sure we are acting in the best interests of our customers, we require a reliable evidence base.

We use the most reliable evidence bases available to us and cooperate with the Environment Agency, Defra, and all our regulators in our research. We will continually update and evaluate our Plans through the periodic reporting process and so will be in a position to act when future risks are identified and justification for adaptation actions found. Through this research we will reduce uncertainty and barriers to adaptation.

7.4 Interdependencies and Stakeholders

We rely heavily on a number of other key industries and authorities. For example, installation of flood resilience at our facilities to protect them against 1 in 100 year plus 20% flows in rivers is undermined if flood defences at power generating sites which supply us with electricity for pumping and water treatment are poor. For this reason although we can move to increase resilience of our business, the benefits of this investment will not materialise if other stakeholders do not invest similarly. In order to overcome this we will work with our interdependencies and regulators such as the Environment Agency to ensure that our adaptation actions remain appropriate. It is hoped that one of the outcomes from the first UK national adaptation programme will be reassurance that all important industries are equally well prepared for the effects of climate change.

We work closely with the Environment Agency who, like us, are in favour of the promotion of demand management, leakage reduction, water efficiency and metering to reduce increases in demand so that more water may be left in the environment. However these initiatives are not economic or cost beneficial compared to increasing water resources. The Environment Agency has specifically excluded us from including order of magnitude costs for sustainability reductions required to deliver the Water Framework Directive requirements in our Water Resources Management Plan. This makes it difficult in turn for us to justify demand management measures on economic grounds.

We will continue to work with stakeholders, conduct willingness to pay surveys and undertake research in this area to determine the amount extra customers are willing to pay for climate change adaptation projects. We will work closely with others on whom we depend and with those who depend on us on the subject of climate change adaptation and feel that the requirement for preparing statutory adaptation plans will enable closer cooperation on climate change issues. We will work with Defra to help facilitate cooperation across key infrastructure and utility owners.

Power cuts could become common as weather conditions cause failures across the energy transmission sector. This, combined with potential future power shortages, will affect the way we pump water across our network. At present, night time pumping is employed to take advantage of reduced energy costs, but if energy tariffs change, more intensive pumping during periods of lower cost will place huge strain on equipment and the network which may not currently have a high enough peak capacity to cope. Also, our current network of pumps is energy efficient providing water supply levels remain within certain parameters.

We currently have no plans to introduce micro generation capabilities sufficient to compensate for power cuts, and so will rely heavily on the resilience of our energy suppliers. If the energy industry is not appropriately prepared for the future then we will be affected as a result.

8 MONITORING AND CONCLUSION

Changing weather brought on by climate change will directly affect our organisation in a number of ways, but it is only through our continued monitoring and research that we can be sure that any proposed adaptation actions are appropriate. Our studies which contribute towards our future planning consider all environmental considerations and climate change has been a part of that for a long time. This report has shown that while we are well prepared for the effects of climate change until the end of our planning horizon, this resilience was not brought about by considering climate change as a specific risk to our organisation.

It is likely that with more adverse weather conditions, we will face new challenges, ones which until now have not been standard occurrences in our region for example, large-scale flood events and droughts. This apparent contradiction highlights the issue of how important knowledge of the actual physical effects of climate change will be and we will continue our efforts to increase our understanding in this topic.

We have, and will continue to prepare for whatever environmental conditions climate change will bring. We have extensively studied various climate models, including the UKCP09 projections from UKCIP but also include historical data and expert opinion wherever possible By embedding climate change adaptation in our organisation we anticipate that we will continue to function effectively in this region and will have the knowledge and experience to adapt to suit our changing environment.

8.1 VWSE and Climate Change

We feel that our current system of operating should serve us well when adapting to climate change in the future. It is flexible enough to respond to any current plausible weather scenario and as this report has shown, effective at identifying changing conditions within our planning horizon. Through our periodic Plans we are able to continue communicating our findings concerning future conditions to our stakeholders and our own staff. Monitoring and preparing for the consequences of climate change is part of our usual planning and this report has shown how our current methodologies and approach is effective.

We aim to take into account worst case scenarios in our planning wherever possible, as our approach to water resources management shows, and feel that our current abstraction and operational methods should be an appropriate framework from which to implement adaptation actions.

As a water company, we are already in the process of adapting to the effects of climate change and feel that the industry as a whole is well informed of the environmental changes we face. We devote a considerable amount of resources to monitoring the effects of changing weather patterns and believe that our planning approach is justified and well researched. We operate in an area of significant water scarcity and it is for this reason that we consider our future planning very seriously.

8.2 Moving Forward

Going forward we will continue to address our priority risks outlined in this report. Through periodic development of our associated Plans, we will monitor environmental changes over time and modify our action plans as appropriate to ensure we can guarantee our business functions across our planning horizon. Our risk assessment methodology may also change depending on our monitoring outcomes.

We will continue to develop our evidence base with others and ensure that our assets and operations are sufficiently resilient to the effects of climate change. As a water company, our performance is intrinsically linked to the environment and therefore a changing climate is of particular importance to us.

If we are able to overcome the barriers mentioned, and remove many uncertainties, it is possible that we will be able to accurately quantify the effect of climate change over and above general changes in our region and prepare adaptation actions accordingly. In order to do this we will work closely with our regulators to ensure our adaptation actions remain appropriate and that we can guarantee service to our customers beyond our planning horizon.

This report has shown that we have a good understanding of the consequences of climate change on our operations and have developed well evidenced and independently verified adaptation programmes. Despite having not completed a specific risk assessment to assess the effects of climate change, our planning approach and methodology is verified to be appropriate by our regulators. We feel that we are as well prepared as is realistically possible until the end of our planning horizon at least and that our customers and stakeholders have every reason to be confident in our ability to maintain our excellent position within the industry.

A. APPENDIX A - CRANFIELD EVALUATION FRAMEWORK: KEY ATTRIBUTES CROSS REFERENCE

This Appendix allows for easier cross reference between the key attributes and sub-attributes of the Cranfield evaluation framework. The Cranfield evaluation framework specifically covers only the risk assessment component of the adaptation reports.

The references provided in this appendix are by no means exhaustive and the main report should be consulted for full details. Assessing the risks as a result of a changing climate and preparing adaptation actions is an integral part of our business operations and so therefore our risk assessment methodology, results and monitoring processes are integrated in all of our decisions. Our approach differs between many of our identified risks and so the main report should be consulted and considered on a risk by risk basis.

Table A: Attributes and sub-attributes of the evaluation framework and relevant cross reference within main report

Key Attribute	Sub-Attribute	Report Reference
1. Climate change risk assessment is a clear component of corporate risk appraisal.	1.1 Climate change demonstrably a key consideration in corporate planning and processes of the Reporting Authority.	2.2, 4
	1.2 Reporting Authority presents a clear analysis of climate risks on business operations for specified periods into the future and includes high priority climate related risks and timescales.	4
	1.3 Adaptation plan is clearly embedded in the core of the Reporting Authority's business.	5
	1.4 Reporting Authority includes some prior evaluation of how its climate change risks impact upon or are affected by stakeholders.	4.1, 4.2, 4.3
	1.5 Reporting Authority considers the existing policies and procedures related to climate impacts, and the effect the weather has on operations and achievement of the organisation's strategic objectives.	4.1, 4.2, 4.3

Key Attribute	Sub-Attribute	Report Reference
2. Climate change risk assessment enables the Reporting Authority to make evidence based decisions on adapting to climate change	2.1 Reporting Authority adopts a conceptual risk management framework for organisational, rather than locational risks.	3
	2.2 Reporting Authority identifies the key climate variables and their potential impact on the organisation.	4.1, 4.2, 4.3
	2.3 Reporting Authority provides clear criteria for likelihood and consequence that are appropriate and specific to their organisation.	3.1.2
	2.4 Reporting Authority's risk assessment quantifies, or otherwise estimates or characterises the impact and likelihood of risks occurring at various points in the future.	3.1
	2.5 Reporting Authority presents all the organisation's strategic risks from climate change on a likelihood/consequence matrix, where possible including the climate thresholds above which climate change poses a threat to the organisation. Where it is not possible, the Reporting Authority should set out how it will investigate thresholds.	Appendix C
	2.6 Reporting Authority considers short, medium and long term risks of climate change disaggregated into different locations where appropriate, and includes an assessment of the level of confidence in these calculations.	4
3. Demonstrable use of relevant and appropriate data, information, knowledge, tools and methodologies	3.1 Reporting Authority adopts the latest set of UK Climate Projections (currently UKCP09) or other appropriate scenarios or climate information.	4.1.1, 4.1.4.1.1, 4.1.4.2.1, 4.2.1, 4.3.1.1
	3.2 Reporting Authority demonstrably assesses using the best evidence suitable to organisational need.	4.1.1, 4.1.4.1.1, 4.1.4.2.1, 4.2.1, 4.3.1.1
	3.3 Reporting Authority's risk assessment includes consultation with interested parties or stakeholders.	3.1

Key Attribute	Sub-Attribute	Report Reference
4. Climate change risk assessment and adaptation measures explicitly consider uncertainties.	4.1 Reporting Authority's risk assessment includes a statement of the main uncertainties in the evidence, approach and method used in the adaptation plan and in the operation of the organisation.	6
	4.2 Reporting Authority's adaptation responses explicitly account for uncertainties and interdependencies of actions, including the actions of others on the adaptation plan.	5
	4.3 Reporting Authority's adaptation plan includes a clear statement of assumptions which are well evidenced.	5, 6
5. Climate change risk assessment generates priorities for action	5.1 Reporting Authority provides priority areas for action that are demonstrably linked to the development of a risk based adaptation plan	5
	5.2 Reporting Authority's adaptation plan includes a detailed action plan covering its priority areas. This should ideally include timescales, resources and responsibilities and be included in the report.	5
	5.3 Reporting Authority's risk management actions are targeted to demonstrably reduce risks to a defined level of residual risk	3, Appendix C
	5.4 Reporting Authority's adaptation plan is subject to appraisal against sustainability principles, and specifically to an appraisal of costs and benefits.	5
6. Climate change risk assessment identifies opportunities	6.1 Reporting Authority's risk assessment allows an evaluation of net benefits and/or opportunities arising from the impacts of climate change	8
7. Clear demonstration of flexible adaptation measures	7.1 Reporting Authority's adaptation plan includes strategies to deal with the level of quantified risk and retains flexibility over which future course of action to follow as knowledge improves and projections change.	5
	7.2 Reporting Authority's adaptation plan includes a statement of the barriers to implementation and a means for overcoming these.	7

Key Attribute	Sub-Attribute	Report Reference
8. Monitoring and evaluation of adaptation effectiveness	8.1 Where possible, the Reporting Authority's report shows progress already made against its adaptation plan.	5
	8.2 Reporting Authority makes clear provision for the evaluation of the effectiveness and viability of its adaptation plan.	5, 8
	8.3 Reporting Authority makes clear provision for monitoring thresholds, above which climate change impacts will pose a risk to the organisation, and their incorporation into future risk assessments.	5, 8
	8.4 Reporting Authority makes clear provision for the monitoring of residual risks from climate change on the organisation and its stakeholders.	5, 8
	8.5 Reporting Authority offers evidence that the production of the risk assessment and adaptation plan has led to a change in the organisation's management of climate risks.	8

B. APPENDIX B - STATUTORY GUIDANCE TO REPORTING AUTHORITIES: BOX 2 CROSS REFERENCE

This Appendix allows for easier cross reference between Box 2 of the Defra Statutory Guidance (*Adapting to Climate change: helping key sectors to adapt to climate change)* and the main body of this report. The statutory guidance to reporting authorities has been issued by the Secretary of State to reporting authorities under powers contained in the Climate Change Act 2008. Its purpose is to provide reporting authorities with guidance and structure when assessing risks due to climate change and developing adaptation actions. Box 2 of the guidance is a summary of what the Secretary of State expects to see on receipt of the completed report.

Veolia Water Southeast's report is of a very similar structure to that laid out in Box 2 and that of the Executive Summary from the same guidance document. As with Appendix A, many of the themes addressed in this table are discussed throughout the entirety of the main report.

Table B: What to include in a report according to Box 2 of the statutory guidance and relevant cross reference within main body of report.

Attribute	Sub-Attribute	Report Reference
1. Functions impacted by climate change	a. What are your organisation's functions, missions, aims and objectives?	2.1, 2.2
	b. Which of these will be affected by the current and possible future impacts of climate change?	2.2
	c. Have you assessed the climate thresholds above which climate change and weather events will pose a threat to your organisation? If so what were the main results?	4
	d. Who are your organisation's key stakeholders? Do you need to assess the impacts of climate change on them?	2
2. Approach	a. What evidence, methods and expertise have you used to evaluate future climate impacts? List sources and references.	4
	b. How do you quantify, or otherwise estimate or characterise the impact and likelihood of risks occurring at various points in the future?	3
	c. How have you evaluated the costs and benefits of proposed adaptation options?	5

Attribute	Sub-Attribute	Report Reference
3. **Summary of risks which affect functions, mission, aims, and objectives**	a. List all the organisations' strategic risks from climate change on a likelihood/consequence matrix – including thresholds where applicable.	Appendix C
	b. What short and long term impacts of climate change have you identified and how are each factored into the adaptation programme? Quantify the likelihood and consequences as far as possible (including an assessment of the level of confidence (e.g. high/medium/low) in the calculations) and disaggregate these risks to different locations where appropriate.	4
	c. What are your high priority climate related risks and why (stating level of impact to business, likelihood, costs and timescales)?	4.1, 4.2, 4.3
	d. What opportunities due to the effects of climate change which can be exploited, have been found?	8.2

4. Actions proposed to address risks	a. What are the adaptation actions for the top priority risks (stating timescales)?	5.1, 5.2, 5.3
	b. How will the adaptation actions be implemented (stating level of responsibility, investment and timescales)?	5
	c. How much do you expect these adaptation measures to cost and what benefits do you anticipate will result from them?	5
	d. How much do you expect them to reduce risk by, and on what timescales?	5
	e. How will you ensure the management of climate change risks is embedded in your organisation?	8

Attribute	Sub-Attribute	Report Reference
5. Uncertainties and assumptions	a. What are the main uncertainties in the evidence, approach and method used in the adaptation programme and in the operation of your organisation?	6
	b. What assumptions have been made when devising the programme for adaptation?	6
6. Barriers to adaptation and interdependencies	a. What are the barriers to implementing your organisation's adaptation programme?	7
	b. How will these barriers be addressed?	7.1, 7.2, 7.3, 7.4
	c. What/who are the interdependencies (including the stakeholders stated in response to question 1d)?	7.4
7. Monitoring and evaluation	a. How will the outcome of the adaptation programme be monitored?	5
	b. How will the thresholds, above which climate change impacts will pose a risk to your organisation, be monitored and incorporated into future risk assessments?	5, 8
	c. How will the residual risks of impacts from climate change on your organisation and stakeholders be monitored?	5, 8
	d. How will you ensure that the management of climate change risks is firmly embedded in your organisation?	8
	e. How will you enable your management of climate change risk to be flexible?	5, 8
	f. Has the production of this report led to a change in your management of climate risks?	8.2

C. APPENDIX C - LIKELIHOOD/SEVERITY MATRIX FOR IDENTIFIED CLIMATE CHANGE RISKS

Our risk assessment approach is detailed in Section 3 and uses a ranking system to identify risks and to divert resources for control actions to where they are needed most. However for the purposes of this report, and to fulfil our statutory reporting obligation, our identified risks have been transferred to a common likelihood/severity matrix. This will allow for easy comparison across the sector but it is worth noting that this is not standard procedure for us. Table 8.2.a below outlines the classification for each identified risk.

Table 8.2.a: Likelihood/severity

Descriptor	Guide
High risk	Should trigger a review of existing controls, is likely to require the implementation of additional controls and the problem should be escalated to the RMC (Risk Management Committee) or relevant committee for consultation. Risk reduction measures should be implemented within a defined time period. Risks with this score should be reviewed monthly.
Significant risk	Should trigger a review of existing controls for new risks, and may require the implementation of additional controls for existing risks and the problem may be escalated to the RMC (Risk Management Committee) or relevant committee for consultation. Risk reduction measures should be implemented within a defined time period. Risks with this score should be reviewed monthly.
Moderate	Should trigger a review of existing controls for new risks, and may require the implementation of additional controls for existing risks. Risk reduction measures might need to be implemented within a defined time period. Risks with this score should be reviewed quarterly to twice a year**.**
Low risk	Should require no mitigation action. However, risk owners should review controls for low risk areas to ensure they are effective and not disproportionate. The risk score should be reviewed annually.

Without Controls in Place

SEVERITY LIKELIHOOD	Low	Quite serious	Serious	Very Serious
Very High				
High			•	
Medium		• FLOOD RISK	• REDUCED GROUNDWATER SUPPLY • INCREASED DEMAND	
Low		• BURST RESULTING IN LOSS OF SUPPLY DUE TO GROUND MOVEMENT	• COASTAL EROSION RESULTING IN LOSS/DEGRADATION OF SUPPLY	

With Controls in Place

SEVERITY LIKELIHOOD	Low	Quite serious	Serious	Very Serious
Very High				
High				
Medium	• FLOOD RISK • REDUCED GROUNDWATER SUPPLY	• INCREASED DEMAND		
Low		• COASTAL EROSION RESULTING IN LOSS/DEGRADATION OF SUPPLY • BURST RESULTING IN LOSS OF SUPPLY DUE TO GROUND MOVEMENT		